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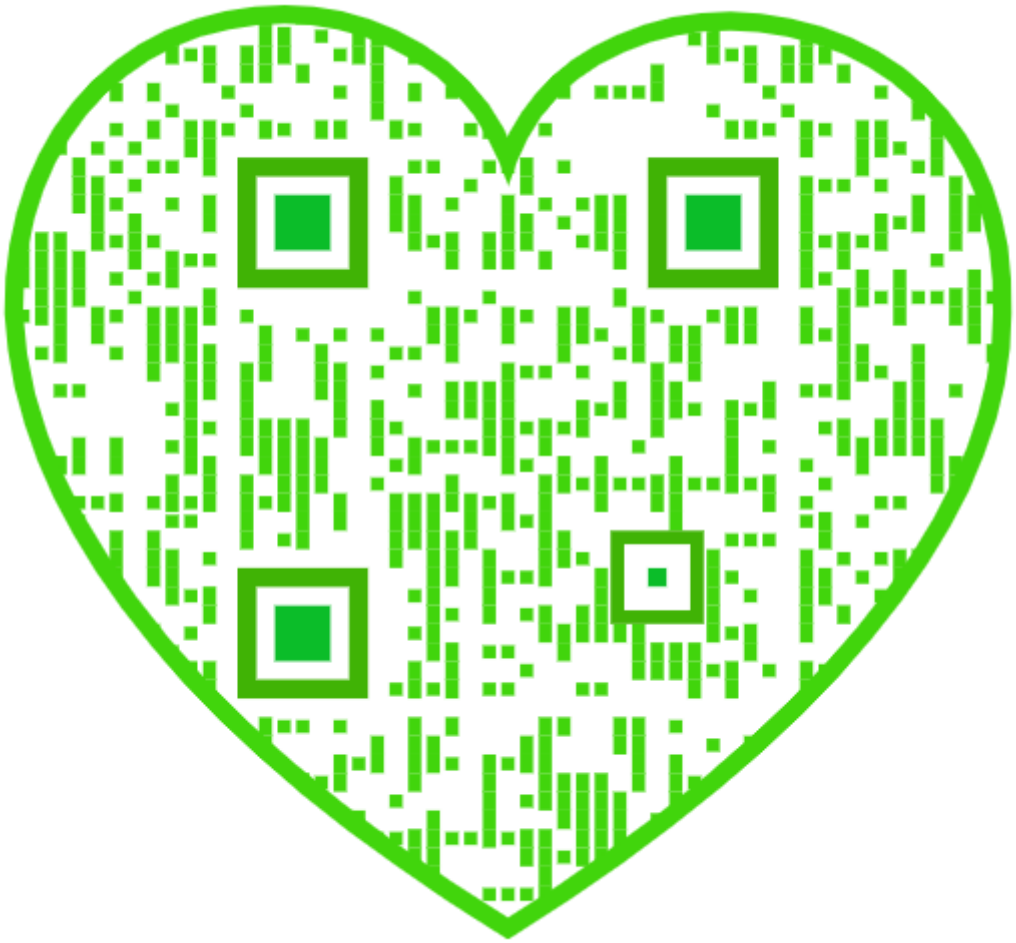

SCIENTIFIC AMERICAN

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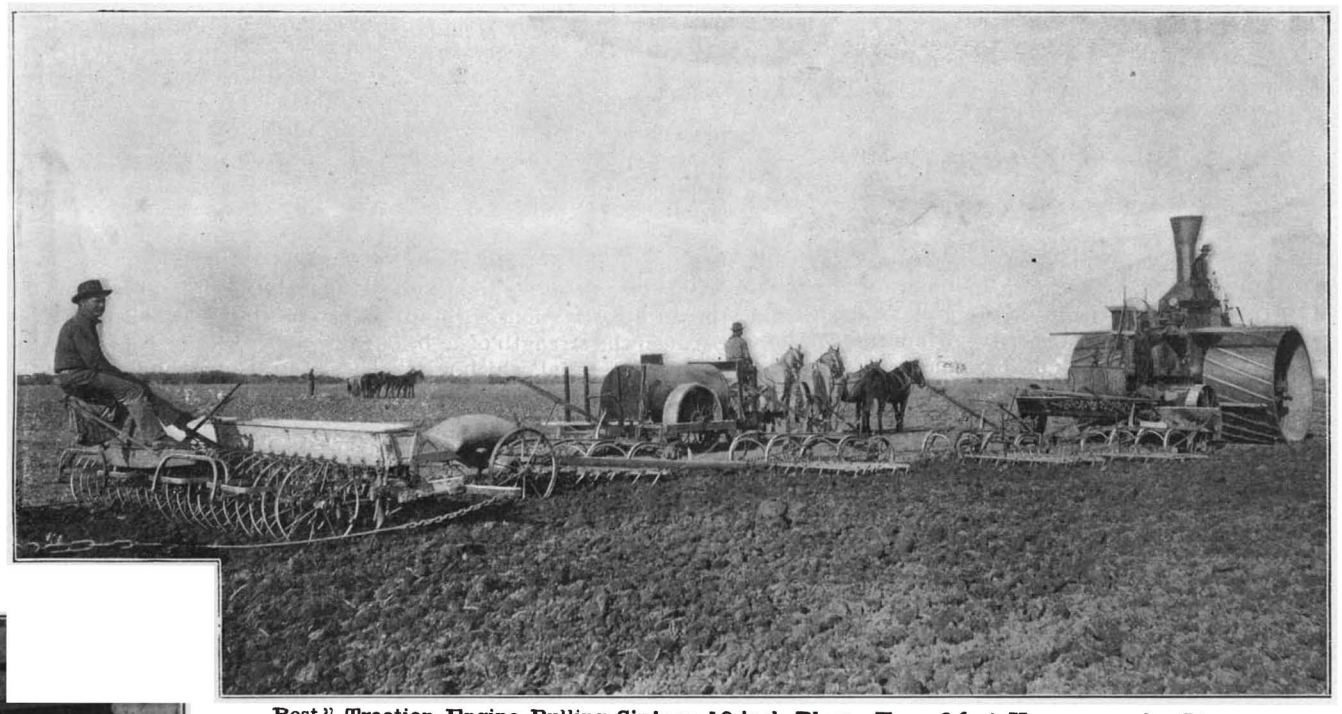
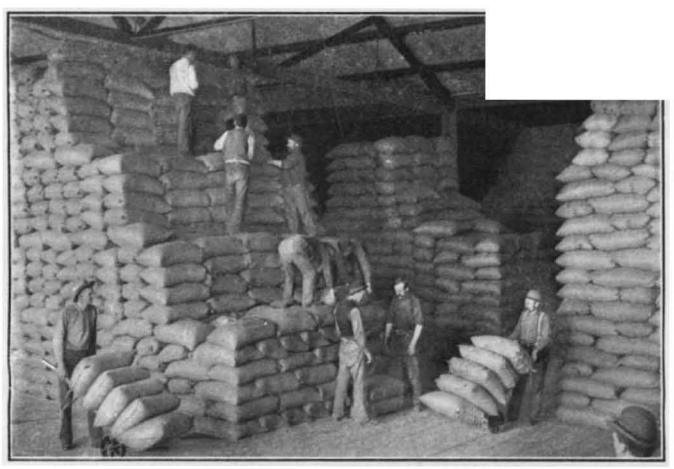
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 1. ESTABLISHED 1845. NEW YORK, JULY 7, 1900. $3.00 A YEAR. WEEKLY.

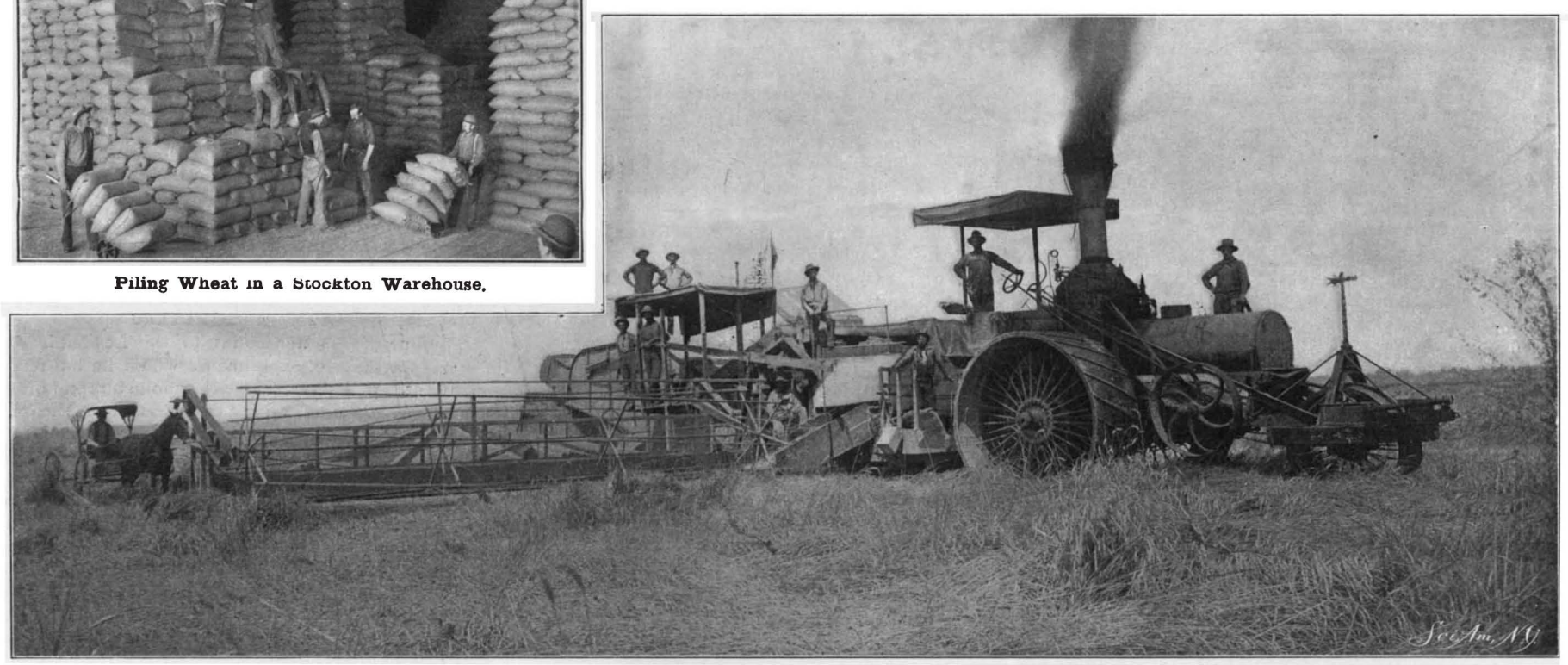
Steam Barge with a Deck Load of Wheat.



Best" Traction Engine Pulling Sixteen 10-inch Plows, Four 6-foot Harrows, and a Havana Press Drill.



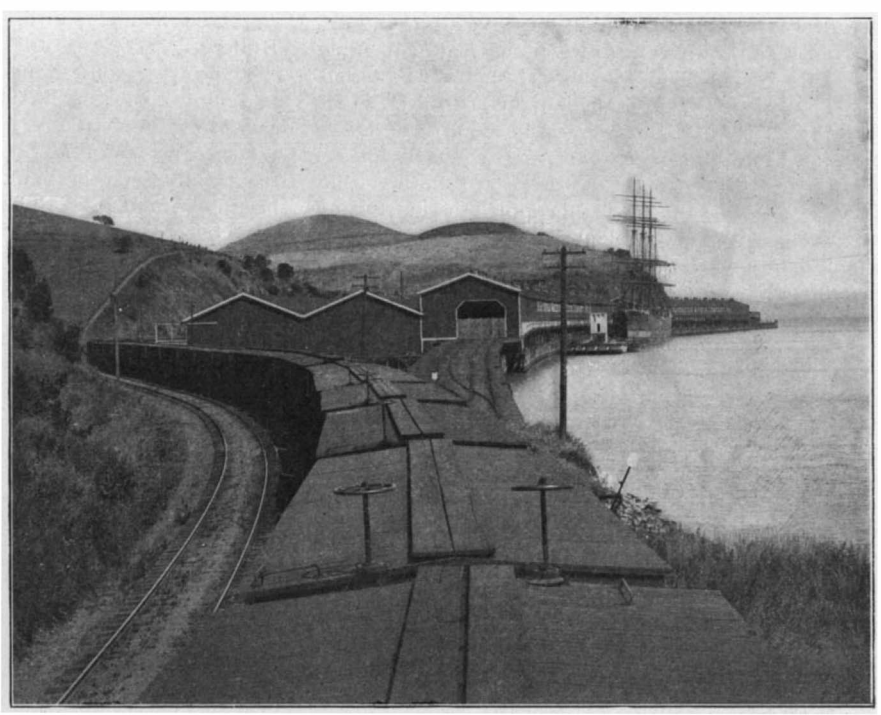
Piling Wheat in a Stockton Warehouse.



The wheat is headed, thrashed, cleaned and sacked by this machine in one continuous operation.

Mammoth Harvester—Cutter, 26 Feet wide; Capacity, 75 Acres per Day.

Flour Mills and Docks at Stockton, the Head of Navigation of the San Joaquin River.



Nevada Docks and Warehouse, a Typical Shipping Point for Deep Sea Sailing Ships.

THE WHEAT CROP OF CALIFORNIA.—[See page 9.]

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AN UNFORTUNATE COMPROMISE.

It is greatly to be regretted that the naval authorities should have compromised on the question of superposed turrets by deciding to build three of our new battleships with such turrets and two without them. The compromise is suggestive of indecision or uncertainty, or at least of lack of harmony on a question which has surely been long enough in debate and on trial to afford ground for definite action. We have the "Oregon" and the "Iowa" as representatives of one type, and the "Kearsarge" and "Kentucky" of the other, and surely by this time the officers of the line and staff have sufficient technical data and sufficient "sweet reasonableness" at command, to be able to get together and decide definitely which type to adopt.

As the matter now stands, there is every reason why a unanimous vote should be given—for the staff, in the person of the naval constructors, have stated that there is no structural objection to the turrets, and the line, in the person of the captains and admirals who fight the ships, are agreed that there is every military reason why they should be adopted. Being thus approved on both structural and military grounds by the experts who are severally qualified to speak from these points of view, where, the puzzled layman will ask, is the bone of contention?

We understand that the last word has yet to be spoken and the last vote taken on this question; and hence there will be an opportunity for the department to reconsider its recent regrettable decision, and commit itself to one type or the other by a unanimous vote.

GARBAGE DISPOSAL OF NEW YORK CITY.

Without entering into the merits of the controversy regarding the Barren Island reduction works, there is no denying that the recent action of the state officials in forbidding the reduction of garbage on the island by the present methods will bring this city face to face with a very serious problem.

In spite of the offensive odors which prompted the recent complaint from the residents in the neighborhood of the reduction works, there is no question that the plant did get rid of an enormous amount of organic refuse, which must otherwise have been left upon the hands of the Street Cleaning Department. Recent figures state that every year 150,000 tons of swill alone, not to mention other forms of refuse, have to be disposed of in some manner consistent with the public health. It will be a decided step backward if the material, which at present is rendered innocuous at Barren Island, were to be added to the garbage which is taken out on scows and dumped into the sea outside the harbor. Such a step would seem to postpone indefinitely the time for which we have all been hoping, when this primitive and, we almost said, disgraceful way of disposing of the city's wastes will be entirely abolished. The miscellaneous rubbish which strews the shores of New Jersey and Long Island, and spreads its disgusting fringe over the various beaches of the lower bay, bears painful witness to the fact that this great city has never yet grappled seriously and scientifically with the problem of garbage disposal.

The foregoing statement is made with full knowledge of the fact that a spasmodic and incomplete attempt was made a few years ago to get rid of a portion of the city's wastes by a method of sorting and burning. While every credit is due to the late Colonel Waring for putting up this experimental plant, it seems that the scheme was inaugurated on too small a scale, and was subsequently too heavily handicapped by political drawbacks, to afford very reliable data as to the cost and efficiency of the process.

Whatever method is to be pursued in the immediate future, it is certain that before long New York must cease to throw its rubbish into the sea and devise some less primitive method. Obviously the first step should be the appointment of an expert commission to go thoroughly into the whole question of garbage disposal, examine the plants installed in various great cities, both here and abroad, and determine upon a system which would best meet the local conditions in New York city.

RELATION BETWEEN TRANSVERSE AND CRUSHING STRENGTH OF TIMBER.

One can scarcely overestimate the value of the elaborate timber investigations planned and carried on by Dr. Fernow as Chief of the Division of Forestry. For many years there has been a great demand for more accurate data respecting the strength of timber, especially when used for heavy structural work. The text books, it is true, have provided tables which are based upon more or less careful investigations; but there is so much divergence between the different authorities, and there are so many varieties of timber, the data regarding whose strength is based upon imperfect experiments, that there has been a pressing necessity for a more comprehensive and scientific investigation.

There is no country where the possibilities of timber as a structural material for heavy engineering work have been more clearly demonstrated than in the United States; and although mild structural steel has displaced timber in many branches of engineering and architecture, timber is still used, and will continue to be used, extensively in many important lines of work for years to come.

One of the most important results of the present timber investigations is the discovery of the relation between the strength of a beam and of a column of the same material, which relation has been deduced and mathematically developed from the many thousand tests made during the extended general test series. During the present winter tests carried out under the auspices of Prof. Roth, of the New York State College of Forestry, furnished experimental proof of the correctness of this relation, which is, that the strength of a beam at the elastic limit is equal to the strength of the material in endwise compression. That is to say, in order to determine what load a beam will carry without injury to its elastic properties, it is sufficient to test the material in compression to the point of failure. The load under which failure occurs is also the breaking load for a beam strained to the elastic limit. The practical value of this discovery is evident; for a simple test in compression gives, without the introduction of difficult formula, immediate answer to the important question of the strength of beam to safe limits. These tests, which were carried out by Prof. C. A. Martin and Mr. George Young, Jr., of Cornell University, removed any doubt as to whether wood possesses a definite elastic limit; which limit, although it is less pronounced in wood than it is in metals, is, nevertheless, readily recognized.

WIRELESS TELEGRAPHY IN SOUTH AFRICA.

The recent visit of Marconi to this country has, in some measure, revived the interest in his system of wireless telegraphy which was aroused during the memorable international yacht races of last summer. We learn that at the outbreak of the South African war an opportunity was presented for dispatching several of Marconi's assistants, and that they took with them complete outfits of wireless telegraphy instruments. It seems that at the outset of hostilities, the capabilities of wireless telegraphy, which were so readily appreciated by the naval authorities, did not seem to commend themselves to the commanders in the field. Instruments had been sent to Generals Buller, White and Methuen; but they failed to develop the plant, and seemed to have looked askance at the new invention, preferring to rely upon the old time heliograph and searchlight signals. In besieged Ladysmith communication was established by means of balloon, by electric signals thrown on the clouds, by heliograph, and even by homing pigeons; but no mention is made at any time of the use of wireless telegraphy, either by the forces in Ladysmith, or by the relief columns under Buller.

There were some generals, however, who gave the system a fair test, and it is characteristic of Lord Roberts that immediately upon assuming command in South Africa he appointed several experts in wireless telegraphy to accompany him. There have been ten instruments in Lord Roberts' army, and the operators have been given every facility to test the system. Little is known as to their practical working, except that it has been in the main satisfactory. The report which will ultimately be given will, no doubt, throw favorable light upon the practical value of wireless telegraphy in land operations. It is worthy of note that the difficulty of providing the necessary elevation for the vertical wire was met by making use of the form of kite designed by Baden-Powell, the brother of the defender of Mafeking.

RECENT DISCOVERIES IN CORINTH.

Four foreign countries, Germany, France, England and the United States, now have schools at Athens. Germany was the pioneer, and the others followed her lead. The United States has one building, and this year there are thirteen students, the largest number in the history of the school. Twenty-three colleges contribute to its support. There is a director, who is selected for a period of four years, and each year he is assisted by a professor who lectures on special subjects. Prof. Rufus B. Richardson, of Dartmouth College, has been director for the last eight years, and under his care the school has distinguished itself by its explorations at Corinth. Six of the students are women, and during the war with Turkey one of them served as a nurse. The school closes about the end of May, when it becomes too warm in Athens for regular work. Some of the students go to Corinth with Prof. Richardson, where they rent a house in the village and push the work of excavation as far as their means will permit.

This year's work at Corinth has been specially devoted to the finding of many small but important objects. It will be remembered that in three campaigns, one important building after another has been excavated, until at last the explorers found themselves inside the Agora. The establishment of the topography of such an important site was a brilliant success. This year they turned the west flank of the Propylæa, and they soon found the way blocked by marble blocks and statues. The first two statues found were a pair of colossal figures 8 feet high, wearing the Phrygian cap, attached to pilasters at the back. Two Corinthian square capitals fitted on to the tops of these pilasters. The figures appeared to assist in bearing at least the architrave, and they were analogous to the famous Caryatides. Two square bases which were also found fitted the figures. This enabled the whole system to be reconstructed from the bottom up.

There were also discovered various fragments of statues, including a very fine head of Ariadne. The crowning success of the year was the discovery made about 75 feet southwest of the western end of the Propylæa, when the explorers came upon the platform 3 feet high with a façade made of metopes and triglyphs, and a coping above them with red, blue and yellow paint still covering them, making a gorgeous show. The façade had a length of about 30 feet and for a part of its extent it had no platform behind and was simply a balustrade. At a bottom of a flight of seven steps was an irregularly shaped room about 25 feet below the surface. In the western wall of the room there were two bronze lions' heads, through the wide open mouths of which water once flowed. Beneath were round holes in the pavements in which pitchers were placed for filling. Prof. Richardson considers, says The Evening Post, that the fountain which the party discovered is an ancient Greek fountain and an absolute unique example. A guard is now mounted over it to prevent its being mutilated. The balustrade at the top of the steps is believed to be Roman in the sense that it was placed there when Corinth was refounded by Julius Cæsar, but it is Greek, and very interesting Greek, because it was taken from the temples which Mummius destroyed.

QUARTZ THERMOMETERS.

M. Dufour gives an account to the Academie des Sciences of a series of experiments which he has made regarding the use of quartz for thermometers and other instruments. As quartz may be softened in the oxyhydrogen blowpipe, and may then be worked like glass, he was able to make tubes of quartz, and afterward thermometers of the same material. Quartz may be applied to the construction of various apparatus, and may be of service; first, where a transparent substance and one not easily melted is required; secondly, where a transparent envelop of definite composition, but slightly affected by hygrometric conditions is called for. The first of these conditions is realized by the quartz thermometer, which consists of a reservoir of quartz and a tube of the same material. As for the liquid, it must be a body which it is easy to obtain in the pure state, and which melts at a relatively low temperature, giving off no vapors up to a red heat; moreover it should contract on solidifying. He finds that tin answers perfectly these conditions, and has constructed a thermometer, using tin as a metal, which reads from 240° to 580° C. As quartz softens only at 1,000° to 1,200°, a thermometer may be made which reads up to 900°; it can be graduated by utilizing the boiling points of mercury and sulphur and the level of the tin is well defined in the two cases. To go higher, the boiling points of cadmium and zinc may be taken. The thermometer was filled with melted tin and as perfect a vacuum as possible was obtained, after which the end was closed by the blowpipe. The last bubbles of air were taken out by melting the tin, while giving it repeated shocks. If the tin has traces of oxide, this adheres to the sides of the reservoir and remains fixed. The upper surface is always brilliant, and has the same appearance as mercury. The reservoir should have rather thick walls to avoid rupture when the metal cools.

M. Dufour hopes that quartz may supersede glass in the construction of vacuum tubes for spectroscope work; he observes that when a glass rod is melted in the oxyhydrogen blowpipe flame there is a disengagement of gas, which is due either to a reaction which is completed at this high temperature, or to the evolution of gases which have been previously dissolved in the glass; on the other hand, quartz melts quietly and no gas is given off. In experiments with spectroscopic tubes, difficulties are met with which

seem to be due to gases given off by the glass; it may be supposed that the use of quartz will remedy these, and as it is a body of definite composition, not oxydized, reduced with difficulty, but little hygrometric and dielectric, it will be seen that it could be used to advantage for making spectroscope tubes. M. Dufour is now making a hydrogen tube of quartz, and expects it to give a perfect spectrum; if so, he will utilize it in establishing a theory of vacuum tube phenomena.

MUIR GLACIER DESTROYED.

The SCIENTIFIC AMERICAN of December 23, 1899, in an account of the great Alaska earthquake of September 10, conveyed intelligence of the probable destruction of the fore part of the Muir as well as all the other glaciers having their outlets on Glacier Bay. The excursion steamer "Queen," on its first trip of the season to this locality, confirmed the correctness of the information published. All of the glaciers fronting on the bay, as well as those of Taku Inlet and Disenchantment Bay, have been shattered by the great earth waves of September, and their sea ramparts cast into the waves by the tremendous shock. The Muir being the greatest as well as the most accessible of the Alaska glaciers, is on that account best known. It has been carefully surveyed and its dimensions approximately estimated. Its main channel extends back into the country for fifty miles and it has forty lateral branches.

At the sea it presents a front two miles long and rises in places 250 feet above the tide. Soundings indicate a depth of 720 feet below, and, therefore, a total height from base of nearly 1,000 feet. Its advance seaward is at the rate of 2,000 feet a year, and every day it is estimated that 200,000,000 cubic feet of ice drops from its face into the sea. Ordinarily a steamer may approach within a mile, but great caution is necessary, as huge icebergs are continually breaking off the sea face, and a vessel once struck by these great masses would be liable to serious damage.

The "Queen" in its recent trip first encountered vast floes of ice about 50 miles distant from Glacier Bay. Continuing to the entrance of the bay, which is 35 miles long and 10 miles wide, the progress of the steamer was greatly impeded by icebergs of most fantastic form, which covered the whole surface. By cautious navigating the "Queen" was enabled to make its way to a point five miles distant from Muir Glacier, where further progress was impossible owing to the packed ice. With the aid of a glass the whole front of the glacier was seen to have been shattered. The familiar palisades had vanished. The wave of the earthquake had leveled the icy rampart to the sea level. The whole aspect of the scene had been changed almost beyond recognition.

The extent of the catastrophe will not be ascertained, perhaps, for years. Until the ice disappears from Glacier Bay, navigation to the foot of the glacier cannot be resumed. Probably one or more seasons may have elapsed before the mightiest natural object of Alaska scenery will be accessible to the view of the tourist.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A delightful and profitable meeting of the A. A. A. S. was held in New York city from June 23 to June 30, with several hundred fellows and members in attend ance, and a long list of papers and addresses on a host of scientific topics. The headquarters of the Council were at the Hotel Majestic near Central Park; and those of the association were at the Columbia University, whose halls, libraries and laboratories were open for the use of the visitors. The anniversary meeting on the evening of Tuesday, June 26, was in the lecture room of the American Museum of Natural History, followed by an informal reception. The New York Aquarium, Botanical Garden, Zoological Park, and various educational institutions were made accessible for the members of the association.

Certain innovations were noted, some of them for the better, and others experimental and of doubtful advantage. Usually, the annual meeting occurs late in August, but was changed to June this year to accommodate those who were likely to go abroad to the international and scientific congresses to be convened in connection with the Paris Exposition. This, however, is not regarded as a precedent, but an exceptional case. Another innovation was the omission of the long-continued custom of inviting some bishop, or other eminent clergyman, to open the first session of each annual meeting by prayer. Quite possibly this opportunity has at times been misused, but this could be avoided by selecting men who were known to be in sympathy with scientific progress. Still another innovation widely commented on was the intentional omission of popular lectures, entertainments, social functions and extended excursions, for which these annual gatherings have hitherto been remarkable. Here again abuses may have crept in, whose correction was a delicate and difficult task; but the question arises if the remedy employed has not been too drastic and extreme. Quite commendable is the novelty of so adjusting the delivery of the nine vice-presidential addresses as to have them given on retiring from office instead of on assuming it, thus conforming to the usage concerning the presidential address.

The most radical departure of all from former usage is the decision to ask no favors of the citizens of the place where the association assembles, but to act independently as to time, place and conditions of meeting. This, of course would simplify matters; but the question arises if it would not diminish the public interest in the transactions.

Concerning all things it would seem that the test is the Constitution itself, which avows as the objects for which the organization exists, "to promote intercourse between those who are cultivating science in different parts of America, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness." If the innovations noted will promote these ends, they are desirable. But the tendency seems to be to narrow the practical work of the association to the wants and tastes of professionally scientific men, instead of promoting the "advancement of science" among those who are in the ordinary walks of life, and yet have a genuine interest in scientific research. Some of the most princely donors to scientific institutions and organizations are persons who would lay no claim to more than a deep and strong admiration for the researches they seek to promote.

Scanning the columns of the daily press, we find scanty reports of the transactions of the association; and scanning the audiences before whom the addresses and papers were delivered, we saw only a few who did not wear the pretty white button indicating membership in the scientific body, or some insignia of the affiliated societies. Few local residents aside from these were present when Prof. Woodward was installed as president, and when President Seth Low, of the university, welcomed the delegates. We had looked for a popular audience to crowd the lecture hall of the American Museum of Natural History when Prof. Grove K. Gilbert, of the National Geological Survey, gave his remarkably lucid and helpful presidential address on "Rhythmic and Geologic Time;" but those present were almost without exception professional scientists. The citizens as such did not attend, nor were they expected, nor had they been invited to do so. We are by no means in a fault-finding mood; but we deem it a duty, as friends of the many thousands who take a deep interest in science, without claiming to be experts, to enter our respectful protest against what seems to be a radical departure from the original and constitutional aims of the association.

There were enrolled about 500 fellows and members, which was a falling-off from the attendance in some of the smaller and interior cities. The list of papers was also smaller than usual. But, on the other hand, the persons who came did so because attracted by a scientific feast, instead of by banquets, concerts, illustrated lectures, parties, and free excursions; and a glance over the daily programmes proved that the discussions took a wide range, though the communications were hardly up to the standard of former years, while some of them were of exceptional excellence.

As usual, a "general session" was held at 10 A. M., which lasted but a few minutes, and then gave way for the sectional meetings in the various halls of the university. Each of the nine sections had its own vice-president. C. L. Doolittle, of Philadelphia, was chairman of the section of Mathematics and Astronomy; Ernest Merritt, of Cornell University, presided over the section of Physics; James Lewis Howe, of Washington and Lee University, Lexington, Va., was in the chair in the section of Chemistry; the vice-president of Mechanical Science and Engineering was John A. Brasher, of the Western University of Pennsylvania; James F. Kemp, of Columbia University, occupied the chair in the section of Geology; C. B. Davenport, of Harvard University, in that of Zoology; the chairman in the section of Botany was William Trelease, of the Shaw Botanic Garden, in St. Louis; the section of Anthropology was presided over by Amos W. Butler, of the Indiana Board of Charities; and Marcus B. Benjamin, of Washington, kept order in the section of Social and Economic Science. Mingled with the sectional meetings were those of the several affiliated societies.

The expression, "kept order," refers to the fact that when men of science get to handling politico-economic questions, they are apt to act like their non-scientific fellow citizens. A rather amusing episode proved this in connection with two very able papers read by the well-known statistician, Edward Atkinson, of Boston. One of these was on the "Distribution of Taxes," the conclusion being as follows:

"Slowly, but surely, the masses of the people find out that wherever the tax may be put, its burden ultimately falls on those least able to bear it. In a country which is under a government of the people, by the people and for the people, the military caste will ultimately be suppressed, and the burden of taxation for any purpose but peace, order, industry and self-defense will surely be removed."

His second paper was on "The Dominion of Iron and Steel. What It Stands For." In this he remarked as follows:

"The principal manufacturing States and countries, except the United States, are dependent countries, to whose people the export of manufactures is necessary to the supply of the means of living. The foundation of all manufacturing and mechanical arts rests upon coal and iron. As yet, no substitute for coal or coke has been found for the smelting of iron and steel, natural gas having served only as a small and temporary substitute. Without iron and steel and coal, Great Britain could never have established her sea power, to which so much importance is given by the advocates of militarism. Commerce is now the dominating power, and war is becoming as absurd and out of date as it is brutal and demoralizing."

These remarks were really mild compared with some of the utterances from the same source. But the breeze arose from Mr. Atkinson's incidentally affirming that "the United States government is spending annually $150,000,000 for the killing off of the Filipinos." This observation struck several members as out of place, and their sentiments were voiced by William H. Hale, of Brooklyn, who never lets his patriotism be hidden under a bushel. He stigmatized the utterance as seditious, and protested against its being printed among the proceedings of the American Association for the Advancement of Science. Mr. Atkinson retorted that he hoped it might be barred out, and reminded his critic that when that experiment had been tried by the government concerning one of his former publications it had ended by 100,000 copies being sent abroad instead of 2,000 copies. He also insisted that, rightly interpreted, his words were not seditious. It is queer that, thirteen years ago, another speaker before the A. A. A. S. was publicly rebuked by this same champion of loyalty who in this instance bearded the Boston anti-imperialist.

Repeated references were made by different speakers to the loss the association had sustained in the death of the genial, wise, and beloved Prof. Orton, of Columbus, O., who presided at the meeting last year. It was decided to hold the next annual meeting at Denver, Col., beginning August 24, 1901. Charles Sedgwick Minot, of Harvard Medical College, was elected president. The general secretary is William Hallock, Columbia University. The permanent secretary is Prof. L. O. Howard, of the Department of Agriculture.

PARIS EXPOSITION NOTES.

The official catalogues of the Paris Exposition are appearing slowly. The only section of the catalogue which was available on May 19 was that relating to the fine arts.

The United States has erected a pavilion in the Champ de Mars, near the Seine, in which are shown a number of exhibits relating to the postal service and the Weather Bureau. Among the exhibits of interest is a model of a 60-foot post office car, as used on the Chicago and Rock Island route; it is constructed on a scale one-sixth, and shows fine workmanship. A striking historical exhibit is the Rocky Mountain mail coach, built in 1868. It was the first to carry the mail in Montana, from Helena to Bozeman, making the trip once a week; it was captured by the Indians in 1877, but recaptured by Gen. Howard, after a hot pursuit. Among the distinguished persons who have traveled in it are Gen. Garfield, before he became President, and Gen. Sherman on his tour of inspection in 1877. Near it is a wax figure of a United States mail boy on a bicycle, carrying the mail bags. Hanging to a column is a mail bag which has a tragic history; it was carried by F. M. Peterson when making the trip to Lochiel, Ariz. He was captured by the Indians and killed; the bag shows the place where it was cut open by the Indians. A fine model of the United States mail steamer "City of Paris" is shown. In a case are assembled a number of historic objects, including a mail bag 240 years old, and said to be the first used in the United States. The first pneumatic carrier sent over the Philadelphia system is shown, and also the first carrier sent in New York over the Tubular Dispatch Company's system by Mr. Chauncey Depew. Another historic exhibit is that of a stuffed horse carrying a wax figure of a mail rider in cowboy costume; the horse was employed in the mail service in Colorado twenty-five years ago, and was killed by being obliged to cover 320 miles in one trip, owing to the absence of a relay. Next to this is a dog-sleigh, carrying two mail bags with three stuffed dogs, and the figure of an Indian mail carrier with leather costume and snowshoes. A number of frames contain different series of periodical stamps, and on the wall above is a representation of a train of cars on the Chicago and Rock Island route, composed of inlaid mother-of-pearl. On the other side of the building are a number of exhibits of the Weather Bureau, showing the different registering machines and the appliances for printing the weather maps. On the roof are installed a number of instruments to represent the working of the system; this part of the exhibit is now being completed under the direction of Prof. Marion.

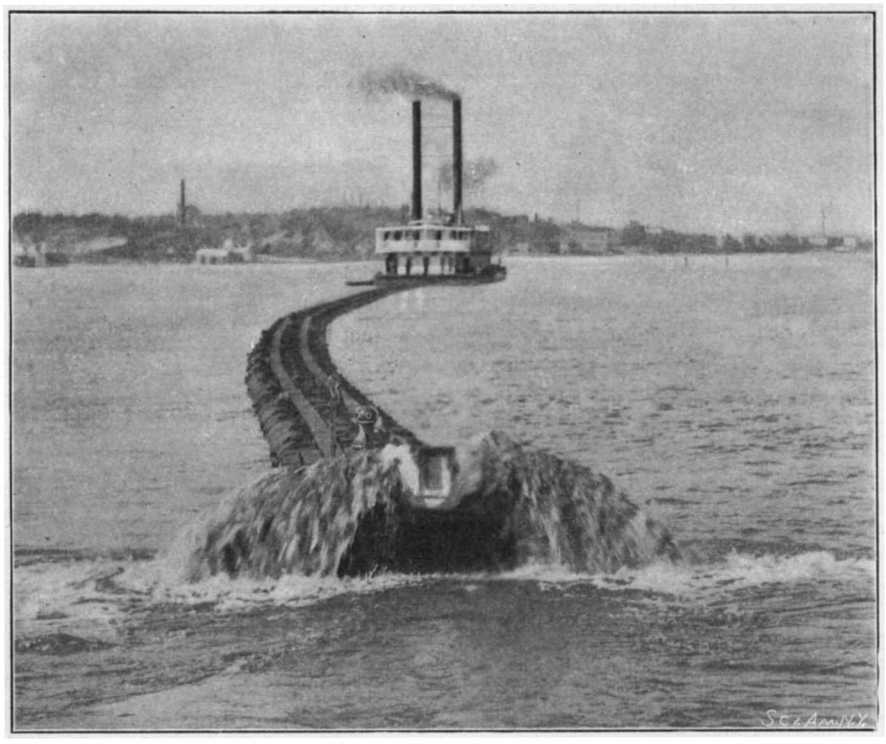
DREDGES ON THE MISSISSIPPI.

BY WALDON FAWCETT.

In no inland waterway in the world is there maintained a more elaborate system of perpetual improvement than on the Mississippi River, and it is no doubt partially due to this policy that the dredging operations on the great American river are more extensive and more systematically conducted than on any other stream on the globe. The character of the river is another factor in the case. Such is the rapidity with which deposits form at many points on the waterway that dredging at short intervals, if a navigable channel is to be kept open, is an absolute necessity.

The improvement of the Mississippi, including of course all the dredging operations, is under the jurisdiction of the Mississippi River Commission, a branch of the engineering department of the War Department. There are in service during the greater portion of the year a fleet of more than half-a-dozen steel-hulled hydraulic or suction dredges. These dredges, most of which have cost over $100,000 each, have all been built within about half a decade. In most instances the hull has been constructed at some point on the Mississippi or tributary rivers; but the major part of the machinery equipment has been supplied by firms in New York, Philadelphia, and other distant points.

The majority of the dredges are capable of dredging from seven hundred to one thousand feet of sand per hour from a depth of fifteen feet. This sand is discharged through at least one thousand feet of floating pipe trailing out behind the dredge; and as there is not infrequently a deflection amounting to as much as five hundred feet, it will readily be appreciated that it is quite possible to thus convey the dredged mass to the bank of the river or to a swampy section of the stream quite remote from the navigable channel. The one thousand feet of floating pipe, with which each dredge is equipped, is made in twenty sections, each fifty feet in length. These sections are floated upon steel pontoons, each about twenty-four feet in length.



The discharge at end of floating pipes.

UNITED STATES DREDGE "GAMMA," UNDERGOING EFFICIENCY TESTS.

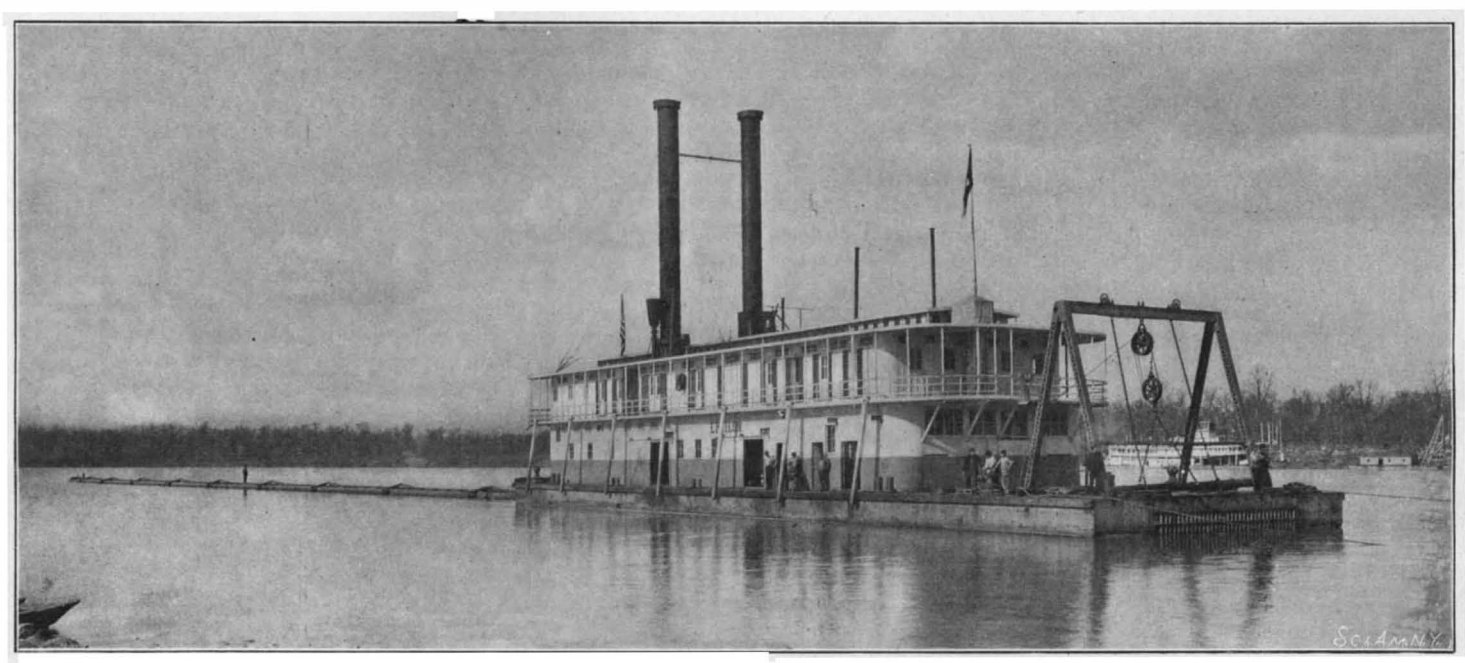
The dredge "Beta," although constructed for the Mississippi Commission several years ago, remains today one of the most interesting machines on the river. The "Beta" has two independent dredging machines complete, and was built at a cost of $172,000. The contract specifications stipulated that the dredge was to have a capacity of at least 1,600 cubic yards per hour, but on her official test an average capacity of 4,920 cubic yards per hour was shown and the contractor therefore earned a bonus of over $86,000. The sand pumps are of the centrifugal pattern, with runners seven feet in diameter and with eight arms in each runner. The suction for each pump divides near the forward end of the hull into three suctions, and each of these suctions was provided originally with a vertical revolving cutter with twelve nickel-steel blades, which serve to loosen up the material, so that it will readily enter the suction. They are driven by engines which make about eight revolutions to one revolution of the cutters. The sand pumps are operated by engines which run at a speed of 130 revolutions per minute and develop 1,250 horse power. Near the bow of the boat are the winding engines, with six huge drums. Two are used for side warping, two for pulling the dredge ahead and two for raising and lowering the suction. About a year or two ago this dredge was reconstructed, and the cutter engines and cutters, above described, were replaced by a jet suction and pumps.

The "Gamma," another of the dredges, has a hull of steel 138 feet in length, 38 feet wide and 8 feet deep. In the bow there is a well for the suctions which is 32 feet long and 22 feet wide. Bulkheads divide the hull into two compartments, one for the boilers and coal, and the other for the engines. There is a cabin 97 feet long and 29 feet in width, and the crew's quarters, with bath room and mess galley, are located below the boiler deck. Between the boiler and engine rooms on the main deck is a fully equipped repair shop. The engines of this dredge are capable of developing about seven hundred horse power. They are supplied with steam from a battery of six boilers of the type in universal use on the inland rivers of America. These steam generators are only 48 inches in diameter, but 28 feet long, and are built to withstand a pressure of 140 pounds per square inch. The coal bunkers on the dredge will hold forty tons.

The "Gamma" is supplied with a powerful pump which supplies the water to stir up the sand at the suction head, and among her other equipments is an electric lighting plant which supplies the current for a four thousand candle power searchlight, four arc and seventy-five incandescent lamps. Exceptional interest attaches to the Mississippi River dredges in engineering circles by reason of the heavy work required of them, and also from the fact that the character of material to be removed in various portions of the river differs so widely as to make the problem of treatment especially complex. In order to give the reader some idea of the strenuous exactions imposed, there may be cited a brief outline of the general efficiency test which the "Gamma" was obliged to meet ere she could be accepted by the United States officials. The stipulations required that the dredge should be operated sixty working days of twelve hours each in water from 5 to 15 feet deep, and with sand at such different degrees of coarseness as would be found on the low-water bars. After this had been done and the machinery found satisfactory, twenty capacity tests had to be made with the suction at different depths.

Something of the staunchness of construction which characterizes these dredges may be imagined when it is stated that the "Delta," another dredge of the same general type as those described, but 175 feet in length, has a weight of upward of seven hundred tons although she draws but a little over four feet of water. Then the floating pipe has a weight of fully 110 tons. The steel plate of which the hulls of these dredges is formed varies in thickness from $\frac{3}{8}$ to $\frac{5}{16}$ of an inch. In 1898, there was designed for the Mississippi River Commission a self-propelling dredge. Save in this feature, however, the plans differed little from those of the dredges of which mention has already been made. The dredges of most recent construction, such as the "Beta" and "Epsilon," are even more elaborate in equipment than their predecessors. In addition to a complete electric light plant they have cold storage facilities, tanks holding over half a thousand gallons of water and several powerful fire pumps. The dredging capacity however remains practically unchanged. Each dredge is designed to make a channel about 20 feet wide at the bottom at each cut. It should, perhaps, be mentioned also that whereas each machine is capable of delivering the sand through 1,000 feet of floating pipe, the line of discharge is frequently of not more than half that length.

Nor is there any reason to suppose that a climax has been reached in the development of Mississippi River dredges. Indeed, Major James B. Quinn, the United States engineer in charge of the government work at the mouth of the Mississippi River, has only recently designed two powerful suction dredges to be used in maintaining the channel at South Pass. They will cost in the neighborhood of $150,000 each and will be about 157 feet in length, 37 feet beam and 16 feet depth of hold, with two propellers and a hopper capacity of 650 yards. Two powerful pumps with 15 and 18 inch suction pipes about 60 feet in length will be suspended alongside the hull. It is estimated that each dredge will have a capacity in excess of 12 cubic yards per minute. These new dredges instead of having the floating pipes will be fitted with shore discharge pipes so that material may be deposited over the levees.



Capacity, 1,000 cubic feet of sand per hour from depth of 15 feet.

UNITED STATES DREDGE "EPSILON."

Loss of Life by Lightning.

The loss of human life by lightning in the United States during the year 1899 was greater than any preceding year for which statistics have been collected. The number of persons killed outright or suffered injuries which resulted in their death was 562; the number of those who received injuries varying in severity from slight physical shocks to painful burns and temporary paralysis was 820 The subject has been treated exhaustively by A. J. Henry, in The Monthly Weather Review, published by the Weather Bureau. The greatest number of fatalities, about 45 per cent, were in the open. The next greatest number occurred in houses, 34 per cent; 11 per cent occurred under trees and 9 per cent in barns. Fully a dozen persons were killed in the act of stripping clothes from a wire clothes line or coming near to one.

The Raddatz Submarine Boat.

The Raddatz submarine boat has been having some additional tests. On June 16, a trip was made under the surface of Milwaukee Bay; there were five in the party. A steam launch accompanied the boat and kept as close as possible to the course of the submarine craft, so as to render any assistance required. The boat was run 18 inches below the surface. It is provided with a diving bottom, from which a diver can be sent to the bottom of the lake, and have air supplied from the tanks aboard the boat. It is thought that the boat will be specially valuable in wrecking operations.

THE NEW AIR SHIP OF M. DE SANTOS DUMONT.

BY FRANCIS P. MANN.

M. de Santos Dumont recently finished the new air ship with which he is to compete for the Aero Club prize of 200,000 francs offered by M. Henry Deutsch, of Paris. It will be remembered that according to the conditions of the prize, aeronauts are to start from the grounds of the Aero Club in the Bois de Boulogne, and take their balloons around the Eiffel Tower, returning to the starting point within half an hour. The new air ship as it appears completed is represented in the illustrations; the gasoline motor is seen in front, as well as the gearing by which it drives the shaft of the screw. The aeronaut sits in the saddle and starts the motor by means of a pedal and chain gear, as in the case of a motor cycle. The upper cylinder contains the gasoline for the motor, and in the lower is a reservoir of water which is used as ballast. The capacity of the balloon is 334 cubic meters (11,795·21 cubic feet) and the motor gives 10 horse power. The surface of the balloon is 292 square meters (3141·9 square feet) and its total length 28½ meters (193·48 feet) with 5·6 meters (18·368 feet) diameter at the middle, giving thus a cross sectional area of 24 square meters (238·24 square feet). The mechanism is suspended 5·3 meters (17·384 feet) below the center of the balloon. Japanese silk is used in the construction of the balloon, which weighs 57 kilogrammes (125·4 pounds) including the weight of the inner air chamber, which has a volume of 35 cubic meters (1236·025 cubic feet). The weight of the ropes, etc., including the guide rope, is 6 kilogrammes 13 pounds), and that of the mechanism 160 kilogrammes (352 pounds). The screw is made of aluminium and steel, covered with silk to enable it to cut the air with the best effect; it weighs 27 kilogrammes (59·4 pounds), and makes 180 revolutions per minute. At the rear of the balloon will be noticed the rudder, which has a surface of 6½ square meters (70 square feet); and is operated by ropes from the car. At the top of the balloon is a valve having a diameter of 40 centimeters (15·6 inches) which is used for the escape of the hydrogen; below are two automatic valves which permit the escape of the hydrogen at pressures of 18 and 15 millimeters (0·7 and 0·58 inch) of water. The inner air chamber is used to preserve the shape of the balloon by compensating for the escape of hydrogen; it has an automatic valve which allows the air to escape at a pressure of 9 millimeters (0·35 inch) of water; it is filled by a rotary pump, which drives air into it as the hydrogen in the outer chamber escapes. The pump is connected with the motor and has a capacity of 3 cubic meters (105·45 cubic feet) per minute, at a speed of 3,000 revolutions.

The motor is of the two-cylinder type, somewhat the same as is used on gasoline motor cycles; the spark for ignition is produced by an induction coil. The motor gives 1,500 revolutions per minute, and this speed is reduced by gearing connected with the shaft of the screw. The illustration shows M. de Santos Dumont mounted upon the saddle; he uses his feet to start the motor and also to work the guide-rope and the weights used to balance the air ship and to cause it to ascend or descend; the hands are thus left free for the other manipulations. The envelop is constructed of Japanese silk, and varnished by a special process. The experience of M. de Santos Dumont with his previous air ship led him to prefer this to all other coverings on account of its uniform structure.

A number of different types of air ships have been constructed before reaching the present model; the last type was somewhat larger, the balloon having 500 cubic meters (17,667·5 cubic feet), while the present balloon has but 334 cubic meters (11,795·21 cubic feet); this reduction in size is due to the fact that the former was inflated with illuminating gas, but in the latter hydrogen is used, which has a greater lifting power. In the former air ship a 3 horse power motor was used, with a speed of 8 miles per hour; the present motor, of 10 horse power, gives a speed of 20 miles per hour. The weight of the present air ship, including the aeronaut, is 350 kilogrammes (770 pounds), that of the former being 250 kilogrammes (550 pounds).

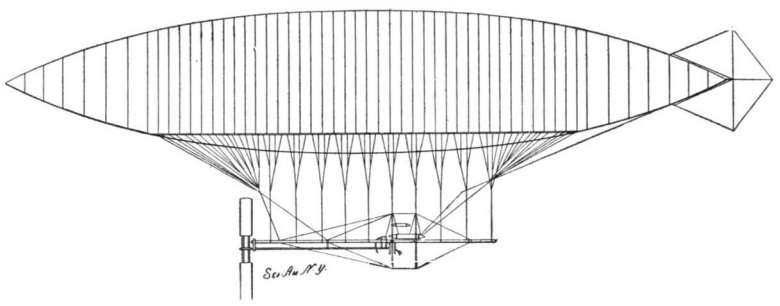
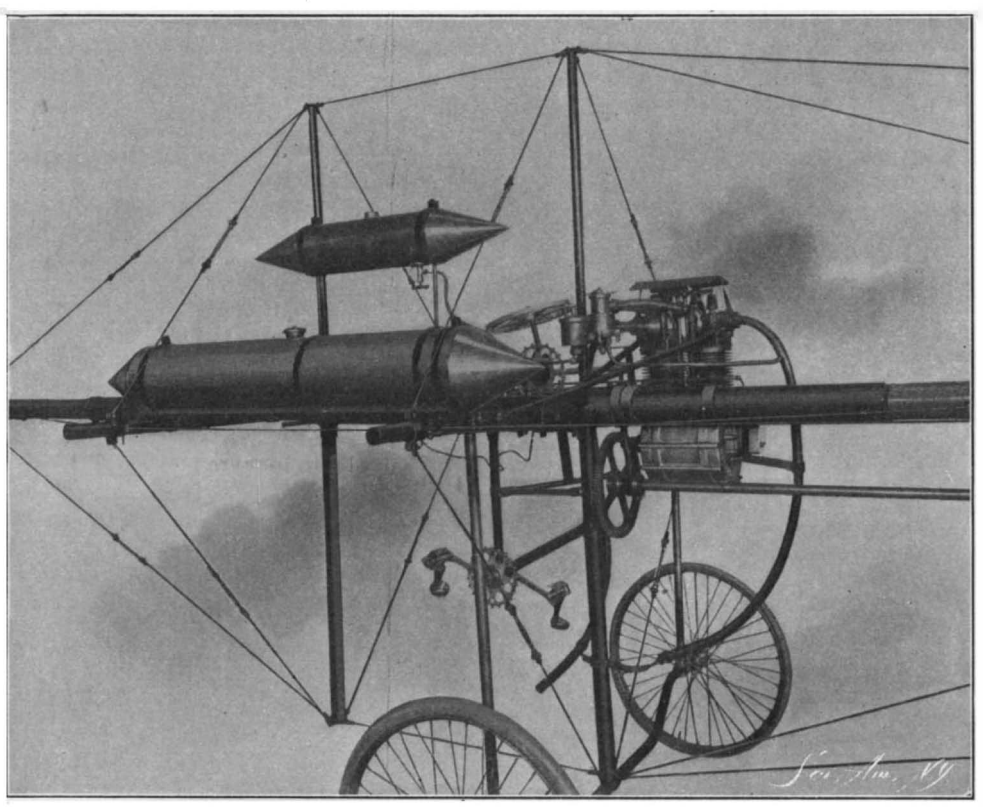


Diagram of the Santos Dumont Air Ship.

According to the conditions of the contest, the competitors are allowed two periods each year to make the trial, these being the first two weeks of June and September, making ten periods in all during the five years. M. de Santos Dumont considers that these seasons are not the most satisfactory for the trials, on account of the wind which prevails at these times in Paris; in the first part of June the weather is changeable, and variable winds are likely to be encountered, and in September, the equinoctial storms. The trials should, naturally, be made in the most favorable weather, as even at best, the problem of steering a balloon is a difficult one; it is expected, however, that the present balloon will stand a certain amount of wind. With a balloon of the ordinary form, M. de Santos Dumont had an accident at Nice a few months ago. The wind came up suddenly, and the balloon was driven against the trees; this wind was followed by a violent storm. The uncertain air currents are thus one of the factors to be considered in the problem. The rules stipulate that twenty-four hours' notice should be given by a competitor who wishes to start, but this puts him at a disadvantage, for owing to the constant changes in the condition of the air it is generally impossible to determine what is to be expected at the end of that time; generally, the ascension is decided upon only two or three hours before the start.



Detail View of Engines, Tanks and Controlling Gear.

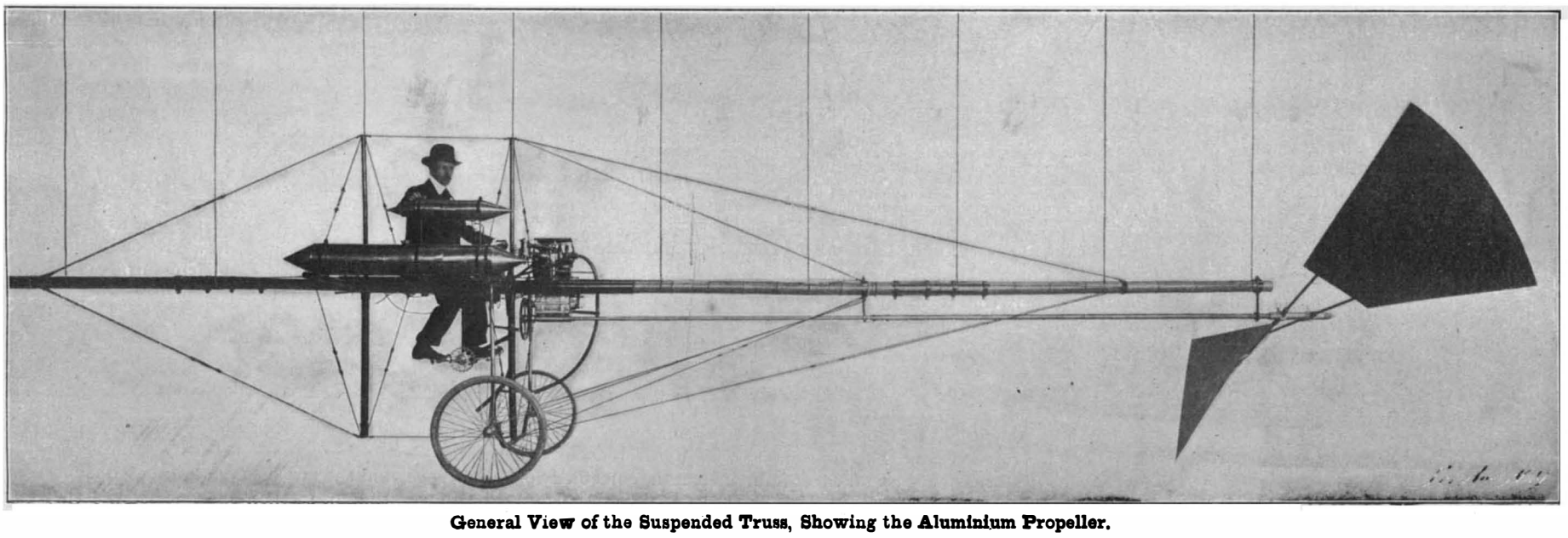
How Machinery Saves Labor.

The Evening Telegram, the other afternoon, summed up the savings in three industries by the substitution of machinery for hand labor as follows. It might equally well have included one hundred as the three named. Forty years ago, when one man was engaged in perforating bank checks, he took 750 hours to do 150,000, at a labor cost of $150; while now, with machinery, six men are employed, but do the work in nine hours and fifteen minutes, and although they get about double the wages per hour, the labor cost is only $1, instead of $150. Again, in ruling paper, the worker using quill and ruler, seventy years ago, took 4,800 hours to do work now done by machine in two and three-quarter hours. The old-time workers got $1 a day, now the two men employed earn $7 per day between them, and yet the labor cost of producing a given quantity is 85 cents against $400. It is easy to understand from this how it is possible to use so much more material and to keep a great army of workers going instead of an individual.

In boot making, machinery is now extensively used, making 100 pairs of men's cheap grade boots in 154½ hours, against 1,436¾ by hand, while the labor cost is reduced from $400 to $35. In women's boots the case is equally marked, for instead of one man being employed to do everything, there are 140 engaged, each on a different machine operation; but not only is the time taken to 100 boots reduced to less than a tenth what it was, but the cost is also reduced. Thus, what was accomplished in ten hours to thirteen hours forty years ago, is now done in an hour.

Again, in bread baking, less than a third of the time is now taken. One thousand pounds of dough for biscuits is rolled, cut and prepared for baking in three hours and fifty-four minutes, as against fifty-four hours by hand.

A NEW electric railway has been opened in St. Johns, Newfoundland. There are 7 miles of track and 20 cars. As the traffic increases the line will be extended to the suburbs. The current is generated nine miles from St. Johns. There is a chain of four lakes, and from the outlet of the last runs a flume which is built along a steep hillside for 3,300 feet until it disappears in a tunnel cut 350 feet through a bluff of solid rock. At the end of the tunnel was erected a huge sluice box of timber, to the bottom of which is fixed a steel tube 6 feet in diameter. Through this the water flows 185 feet to the power house. The capacity of the plant is 1,600 horse power, but the flume is of sufficient capacity to drive another plant of the same size.



General View of the Suspended Truss, Showing the Aluminium Propeller.

SANTOS DUMONT AIR SHIP—A COMPETITOR FOR THE GRAND PRIZE.

THE DIFFERENCES BETWEEN MALARIAL AND NON-MALARIAL MOSQUITOES.

BY L. O. HOWARD, PH.D.

The attention of the medical world is now focused on the mosquitoes of the genus Anopheles owing to the fact that the species of this genus have been shown to be carriers and transmitters of micro-organisms of human malaria. The more abundant mosquitoes of the genus Culex have not been found to be able to transmit malaria germs. The biology of Culex has been known since the 17th century, but that of Anopheles has never been described, so far as the writer knows. So many physicians are taking up the study of the mosquito-malaria relation under local conditions in different parts of the country that it is highly important that they should be able to distinguish at once between Anopheles and Culex in any stage of growth. During the present spring the writer has worked out the life history of *Anopheles quadrimaculatus* at Washington and has carefully figured all stages. It is strikingly different from Culex in every stage from the egg to the adult, as a glance at the figures accompanying this article will readily show. It also differs in habits. The two species contrasted in this article are *Culex pungens* and *Anopheles quadrimaculatus*.

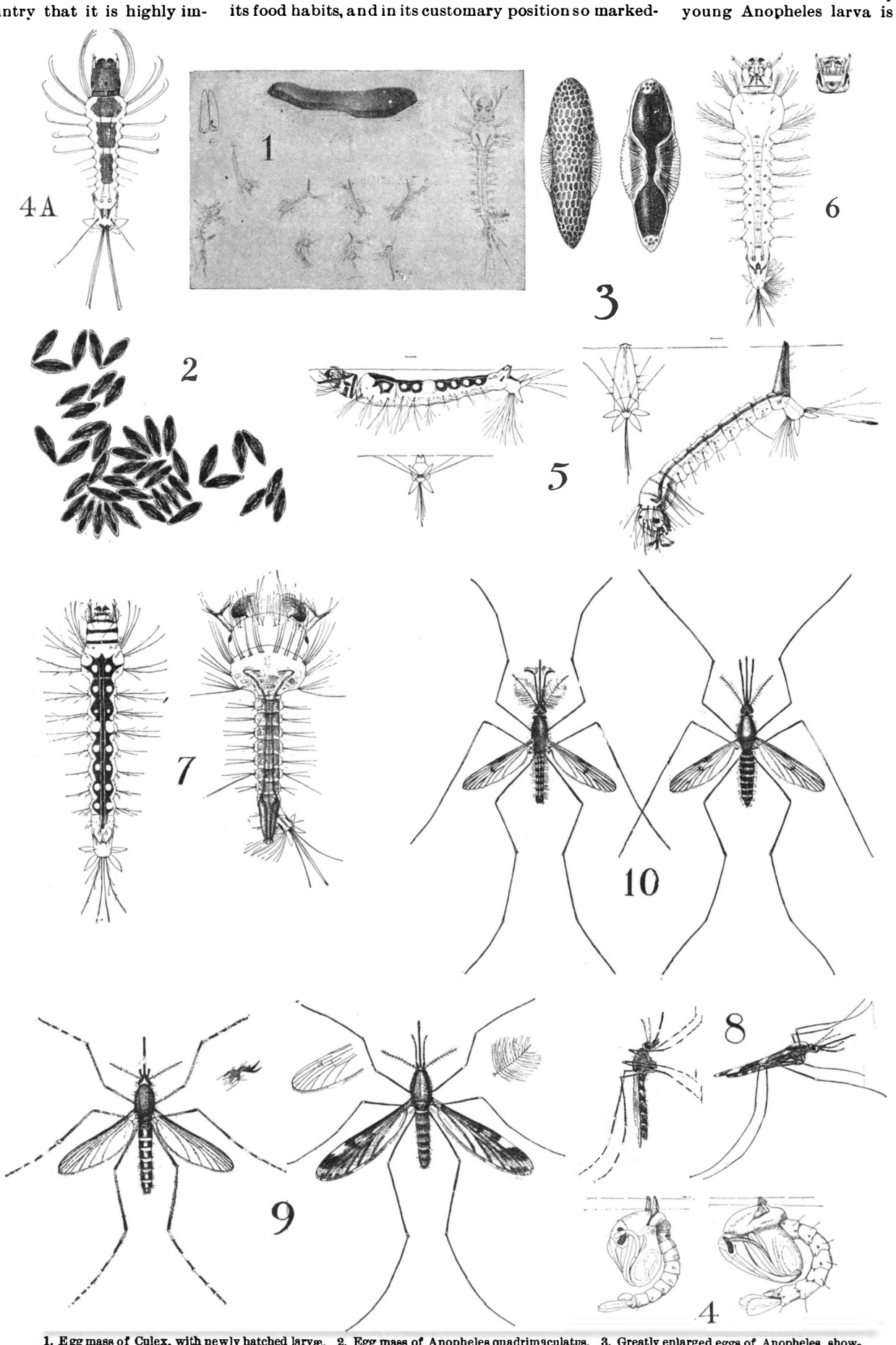
THE ADULT.—The main structural difference between Culex and Anopheles in the adult condition is that the palpi of Anopheles are nearly as long as the sucking beak, whereas in Culex they are very short. Anopheles, as a rule, has spotted wings, while the wings of Culex are as a rule not spotted. The males of both genera are readily distinguished from the females by the fact that the antennæ and palpi are feathery in the male, and not feathery in the female.

Resting Position.—A member of the English Malarial Expedition to Sierra Leone made a rough field sketch, which was published in The British Medical Journal, and which is here reproduced, which indicates that in resting the adult of Anopheles hold its body nearly at right angles to the surface upon which it stands, whereas in Culex the body is nearly parallel to this surface. Observations at Washington showed that this difference holds when the mosquito is resting upon a ceiling or any other horizontal wall, but not when it is resting upon a perpendicular side wall. In the latter case Anopheles frequently holds its body nearly parallel with the wall. A uniform difference, however, is seen in the fact that in Anopheles the body and beak are always held in about the same plane, whereas in Culex the head and beak form an angle with the rest of the body.

Note of the Female.—The peculiar hum of the mosquito is well known. There is a distinct difference between the hum of *Anopheles quadrimaculatus* and that of the common species of Culex in that the former is noticeably lower in pitch. The note of Culex as it approaches the ear is high in pitch while that of Anopheles is certainly several tones lower and of not so clear a character. In quality it is something between the buzzing of a house fly and the note of Culex.

THE EGGS.—The eggs of Culex, as is well known, are placed perpendicularly on the surface of the water closely joined together into a boat-shaped or raft-like mass. Those of Anopheles, however, are radically different. With *Anopheles quadrimaculatus* the eggs are laid loosely on the surface of the water, each egg lying upon its side instead of being placed upon its end as with Culex. They are not attached to one another except that they naturally float closely to one another, and there are about 40 to 100 eggs in each lot. The individual egg is of a rather regular elliptical shape, strongly convex below and plane above. Its characteristic appearance is shown in the accompanying figure. It is 0·57 mm. long. The eggs are laid at night, as with Culex, and hatch in from three to four days in May.

THE LARVÆ.—The larva of Anopheles is quite as unlike that of Culex as is the egg. It differs in structure, in its food habits, and in its customary position so marked-



1. Egg mass of Culex, with newly hatched larvæ. 2. Egg mass of Anopheles quadrimaculatus. 3. Greatly enlarged eggs of Anopheles, showing structure (from below at left, from above at right). 4. Pupa of Culex pungens (at left), and of Anopheles quadrimaculatus (at right). 4a. Newly hatched larva of Anopheles. 5. Half-grown larva of Anopheles (at left), and Culex pungens (at right), showing position with reference to the water surface. 6. Full-grown larva of Anopheles; dorsal view; head reversed in feeding position; dorsal surface of head at right. 7. Half-grown larva of Anopheles (at left), and of Culex (at right). 8. Resting position of Anopheles (at right), and of Culex (at left), redrawn from British Medical Journal. 9. Adults of Culex tæniorhynchus (at left), and Anopheles punctipennis (at right), showing structural differences between the two genera. 10. Anopheles quadrimaculatus, adults; male at left, female at right.

THE MALARIAL (ANOPHELES) AND THE NON-MALARIAL (CULEX) MOSQUITO.

surface of the water. Its breathing-tube is much shorter than that of Culex, and its body is held not at an angle to the surface, but practically parallel to the surface and immediately below the surface film. Its head rotates upon its neck, and it feeds with the underside of the head upward, the venter of the rest of the body being below. In this customary resting position the mouth parts work violently, the long fringes causing a constant current toward the mouth of particles floating on the surface of the water which eventually enter the alimentary canal. The spores of algæ, bits of dust and everything which floats follow this coarse and can be seen to pass through the head down into the alimentary canal. The color of the young Anopheles larva is dark, nearly black, while that of Culex is light gray or faintly yellowish. Since the Anopheles larva feeds only upon these light floating particles its specific gravity is nearly that of the water itself, and it supports this horizontal position just beneath the surface film with ease. It requires an effort for it to descend which it apparently never does, up to the period of the final larval stage, except when alarmed. The structural differences are very marked, the great size of the head and thorax of Culex as contrasted with the small head and thorax of Anopheles being shown plainly in the illustration. The arrangement of the hairs is entirely different, as the figure indicates, and the compound hairs of Anopheles contrast strongly with the simple hairs of Culex. As already pointed out, the very long breathing-tube of Culex is entirely different from the very short one of Anopheles. The larvæ of Anopheles feed with avidity upon the spores of algæ which seem to be their proper food. Those studied were in jars in which occurred algæ of the genera Oedogonium, Cladophora, Spirogyra and Oscillaria. They reached the last molt in 10 days, considerable cold weather, however, having intervened, and remained in the last larval stage, 6 days, transforming the pupæ 16 days after hatching.

THE PUPÆ.—The differences in this stage between Culex and Anopheles are not so marked as in the larval stages. The structural differences are shown in the accompanying illustration. The difference in resting position is rather marked, the pupa of Culex resting in a more perpendicular attitude than that of Anopheles, and there is a marked difference in the shape of the respiratory siphons, which now issue from the thorax instead of from the anal end of the abdomen. The pupa of Anopheles is quite as active when disturbed as that of Culex. If one touches the nearby surface of the water the pupa at once wriggles violently downward, returning shortly to the surface for air.

The extreme activity of both larvæ and pupæ of mosquitoes is a necessary factor in their struggle for existence, since stagnant pools of water swarm with predatory animal life. The larva of one of the water beetles of the family Hydrophilidæ, for example, eats hundreds of other aquatic insects in the course of its existence, and the larvæ of mosquitoes do not escape entirely, although by their extreme activity they stand a better chance than do other more sluggish species.

The duration of the pupa stage of Anopheles varies

ly that it can at once be distinguished with the utmost ease. The larva of Culex comes to the surface of the water to breathe, thrusting its long breathing tube through the surface layer and holding its body at an angle of about 45° with the surface of the water. It descends at frequent intervals toward the bottom, to feed, returning to surface every minute or two. Its specific gravity seems to be greater than that of water so that it reaches the surface only by an effort and when it is enfeebled for any cause and is not able to wriggle up to the surface it drowns. The larva of Anopheles, however, until it becomes nearly full-grown, habitually remains at the

according to the weather. Five days was the minimum observed during June, although several specimens remained in this stage for 10 days. The entire life-round, therefore, of *Anopheles quadrimaculatus* is as follows: Egg stage, 3 days; larval stage, 16 days; pupal stage, 5 days; making a total for the early stages of 24 days. It should be stated, however, that during the early larval existence in May there occurred nearly a week of cool weather, so that it is certain that in the hot season of July and August the growth and transformation will be more rapid. In 1895 the writer traced one entire generation of *Culex pungens* in June in 10 days.

The writer is frequently asked as to the duration of the adult stage of mosquitoes, but beyond the statement that the adults hibernate, living in this condition from November to April in the latitude of Washington, D. C., he has been unable to give a satisfactory answer. They die rather quickly in confinement in the summer. Anopheles hibernates in the adult condition, and the writer has had living specimens in confinement in breeding jars for 8 days, all dying at the expiration of that time. This, however, is not a fair indication of the length of free individuals, and as the specimens in question were all captured specimens, they had lived an unknown number of days before capture. There are two genera of large mosquitoes found rather commonly in our Southern States—Megarrhinus and Psorophora, which Southern investigators should study as to their possible function as carriers of the malaria plasmodium. Neither of these forms has been studied in this connection, and it seems to the writer that from their large size and blood-sucking propensities their possibilities as transmitters of blood-inhabiting micro-organisms are great.

THE WHEAT CROP OF CALIFORNIA.

Cultivation of wheat in California will long continue to be one of the greatest sources of wealth to that surprisingly fertile State. The history of the industry is perfectly well defined. Introduced by the fathers of the missions, in 1769, from seed brought from Mexico, the adaptability of the country for the growth of cereals was quickly demonstrated, and the object accomplished of rendering the country independent of Mexico for its breadstuffs. During the supremacy of the missions enough wheat was raised to more than supply the scanty population of the period, and this condition of affairs continued until the confiscation of church property in 1824, after which the cultivation of wheat declined. In 1847, but little wheat was produced and that of a very inferior quality. The era of gold mining interrupted agricultural pursuits for several years, but, by 1854, the local crop began to appear upon the market in increasing quantities and to gradually displace importations from South America and the East.

The exportation of California wheat to English ports, probably as ballast, has been followed by ever increasing shipments until now a hundred of the finest sailing vessels of the world's fleet are employed in the traffic.

The new era, beginning with the American occupation of the country, was due to the great influx of a highly intelligent class who came in search of gold. Probably not five per cent of these people contemplated a permanent stay. They knew little about the agricultural possibilities of this new land, and never suspected that the riches of the gulches were actually secondary to the wealth that lay dormant in the soil. Unsuccessful in the quest of gold, and with resources greatly impaired, these men were obliged to return to their familiar occupations as agriculturists and of necessity to the cultivation of crops requiring the least labor to mature, and to such as would find the promptest market at remunerative prices. Hence, the early attention given to raising wheat. The bay and river system of the country gave access to the most fertile valleys of the world in every direction. Acres and acres of virgin land only required the scratch of the plow to yield abundantly. In six months crops could be gathered and brought to market and sold at prices that meant riches. Hence, in 1854, the crop of wheat amounted to enough to supply the country and allow a small quantity for export.

The acreage devoted to wheat continued to increase until 1899, when it amounted to 3,300,000, with a crop of 18,723,680 centals. Since then the acreage has gradually become less. In 1899–1900 there was (estimated) 2,750,000 acres in wheat with a crop (estimated) of 20,000,000 centals.

The conditions insuring a large wheat crop in California cannot be said to depend upon the quantity so much as the timeliness of the rainfall. The great crop of 1880 was produced with a rainfall of but 16·74 inches (in San Francisco), at least 10 inches below the annual average.

Lands devoted to wheat in California include those reclaimed from the beds of rivers by embankments, which have been under water for ages and never produced anything but rank growths of vegetation. Once protected from overflows, the crops of fruit, vegetables or cereals grown upon these lands are surprising. Instances of 40 sacks of wheat, averaging 130 pounds, as the product per acre of a reclaimed farm, multiply; and knowing their exceeding fertility and witnessing the rank, powerful growths of the stalk before harvest time, such a yield ceases to astonish. Wheat grown upon these soils, however, does not rank in quality with the best.

Lands which are protected from overflow by artificial levees, of which there are hundreds of thousands of acres along the banks of the Sacramento and San Joaquin Rivers, are the finest wheat lands of the State, and the most valuable. Lying low, they are independent of drought, and their natural fertility has been augmented by deposits brought down by overflows before the levees were constructed. The Yalo basin on the Sacramento River, in time of harvest, is a sight beyond description. The wide, level valley, stretching on both sides of the river, is a golden sea of vegetation. The great Glenn ranch of 60,000 acres, all in wheat, is situated here. The high lands, located above the influence of river floods, and dependent upon rainfall for moisture, extend in these valleys to where the foothills begin. They are of vast extent, and produce the finest, deepest and weightiest wheat grown in the world. They average, perhaps, six sacks, of 150 pounds each, per acre.

After persistent cultivation the reclaimed and leveed lands show no signs of exhaustion. No fertilizers have ever been added to these fields other than the charred straw burned after each harvest. The high lands, some after fifty years of continuous planting to wheat, upon which no fertilizers have ever been spread, do show the effects of wear, though these lands are quickly restored to their old fertility by deep plowing and a change of crops. Alfalfa substituted for wheat for a few years, and then a change back to wheat, has shown as fine crops on these soils as were ever raised.

These high lands are all capable of irrigation. In Merced County, where thousands of acres of wheat are planted under the superb irrigating system there established, crops never fail and are always of huge dimensions.

The fortunes so rapidly acquired by the early wheat growers naturally influenced others to follow their example; but the scarcity of laborers became a serious problem when the wheat area increased to hundreds of thousands of acres. Then it was that mechanical ingenuity supplied the means for plowing, cultivating, seeding, and harvesting the enormous wheat crops.

To California mechanics is due the distinction of instituting steam for hand labor in manipulating cereals in the fields. Huge 50-horse power traction engines, of the "Best" type shown in our illustrations, with driving wheels 60 inches in diameter, and flanges 60 inches in width, drawing over the fields sixteen 10-inch plows, four 6-foot harrows, and a press drill to match, plowing, harrowing, and seeding from 45 to 75 acres at one operation each day, explains why the vast crop of California, covering millions of acres, can be planted and cultivated in a country where the supply of labor is not great enough to plant a crop one-tenth part as large. In the harvest time, by the aid of one of those enormous harvesters, whose cutters are 26 feet wide, the wheat is at once headed, thrashed, cleaned, and sacked, ready for market, the machine in one day gathering the crop of seventy-five acres.

To observe one of these enormous machines traveling over the uneven surface of these fields, crossing wide ditches, or crawling along the side hills, surmounting every obstacle with the most perfect ease, and automatically gathering in the ripened grain, sacked ready for market, is a sight of the rarest description.

These mechanical prodigies are adapted only for countries like California, with seasons of wet and dry, well defined, where cereals ripened by hot suns easily fall from the husks. For the moist lands of the great North these harvesters have not proved an entire success.

Preparing the ground for the coming wheat crop in California differs little from the methods used in other countries, though "deep" plowing is not common. On the higher lands the furrow is never over 6 inches in depth, and rarely over 5 inches. Deeper plowing is thought to dry out the land too fast and is avoided on that account. Summer fallowing is on the increase, and to allow absolute rest in alternate years is more and more encouraged. Five crops in ten years aggregate, it is found by experience, as much as yearly crops would do. In summer fallowing, plowing during the late spring rains is the custom. The land lies undisturbed, with the exception of running over a weeder during the season. On the first rain the cultivator is run over the ground, which is seeded at the same time, and then cultivation is over. No further attention is required until the maturity of the crop.

The marketing of California wheat bears no resemblance to the methods of the great Northwest. Wheat in bulk is unmarketable. Shippers and exporters refuse to handle it. A cargo in bulk was once sent to Liverpool; the ship was never heard from. Since that time shipments in sacks only are permitted. Otherwise no insurance can be effected.

San Francisco, Port Costa and Stockton are the great tidewater markets for wheat. The latter city is the great manufacturing center of the coast. Its great flour mills turn out 8,000 barrels every day. It is at the head of navigation of the San Joaquin River system and an important station of two transcontinental roads. Its warehouses have a capacity for 120,000 tons. Its flour is known the world over. The flour mills of the State have a capacity of 20,000 barrels daily. San Francisco has a warehouse capacity of 120,000 tons, under the control of its Produce Exchange. All foreign shipments are arranged at this port, and every question of values, insurance, or exchange adjudicated. The operations of the Produce Exchange are enormous in their volume, and it enjoys the unlimited confidence of merchants, foreign and at home.

Port Costa, forty miles north of San Francisco, on the bay, has warehouse facilities for 290,000 tons. The great storehouses extend for miles along the water front, and at these docks ships from all over the world find the best facilities for prompt loading. This point is the head of deep water navigation on San Francisco Bay, and there have been seen forty vessels at the docks at one time, all waiting for cargoes for foreign countries.

California wheat and flour find a market in Europe, Mexico, Central and South America, Australia, China, and Japan. The islands of the Pacific are taking increased quantities. Siberia is becoming an active customer, and South Africa, until war interrupted, consumed large amounts. Flour as well as wheat is handled only in sacks.

The future of California wheat is dependent upon price. At a rate remunerative to the grower the quantity now raised could be greatly exceeded. With a plentiful supply of moisture, such as an intelligent conservation of the resources of streams now going to waste would assure, the wheat crop of the State could be quadrupled.

The correspondent of the SCIENTIFIC AMERICAN is indebted to the Hon. W. B. Harrison, Mayor of Stockton, and Mr. J. W. Welch, Superintendent Stockton Milling Company, for valuable assistance in the preparation of the present article.

Formation of Selenide of Zinc.

At a recent meeting of the Académie des Sciences, M. Forizes-Diacon describes a series of experiments in which he obtains the selenide of zinc in two different crystalline forms. By causing the vapors of selenium to react upon zinc at a high temperature, M. Margottet obtained an amorphous selenide of zinc which, when strongly heated in a current of hydrogen, gave rise to long needles, yellow by reflection and red by transparence; these crystals derive from the cubical system. As sulphide of zinc crystallizes, according to circumstances, in the hexagonal or the cubical system, the experimenter wished to prepare a hexagonal form of the selenide of zinc, which would thus show a similar dimorphism. By reacting upon chloride of zinc in vapor with a mixture of nitrogen and hydrogen selenide, he obtained fine crystals, yellow by reflection and greenish by transparence; these took the form of long needles which carried laterally hexagonal prisms, acting strongly upon polarized light. The crystals correspond to the formula Zn Se, and belong, like the mineral würtzite, to the hexagonal series. The experimenter also tried to prepare the selenide of zinc at the temperature of the electric furnace by heating in a tube a mixture of seleniate of zinc and carbon. The walls of the tube were lined with amorphous selenide, which presents crystalline masses of an indistinct character. The next experiment was made by heating precipitated selenide of zinc in a carbon crucible placed above the electric arc for 10 minutes; after the operation, the crucible contained a melted mass, crystalline at the surface, showing parts of a gold-yellow color; these crystals are not sufficiently distinct to determine their system, but they have no action upon polarized light; their density, 5·42 at 15° C., is very near that of the crystals obtained by M. Margottet. By reducing seleniate of zinc by hydrogen in a porcelain tube at a white heat, clusters of selenide of zinc are obtained in the form of long needles of a greenish color; these seem to be elongated rhomboids. The crystalline selenide of zinc dissolves in fuming hydrochloric acid, giving off hydrogen selenide; gaseous hydrochloric acid is almost without action upon it, even at high temperatures. Chlorine decomposes it by displacing the selenium. It burns in oxygen, giving a basic selenite and selenious anhydride, which is sublimed. By a similar method, the experimenter has obtained a selenide of cadmium in crystals of the hexagonal system.

THE Empire State Sugar Company, which is building a large beet sugar plant at Lyons, N. Y., has ordered ten auto-trucks of five tons capacity, which are to be used to cart sugar beets from farms to the refinery. The company has 5,500 acres of land contracted for. Three electric omnibuses have also been ordered to run between Lyons and Sodus Point, on Lake Ontario, a summer resort, to compete with the steam railroad.

GOLD MINING IN GEORGIA.

BY WILBER COLVIN, PROFESSOR IN THE NORTH GEORGIA AGRICULTURAL COLLEGE.

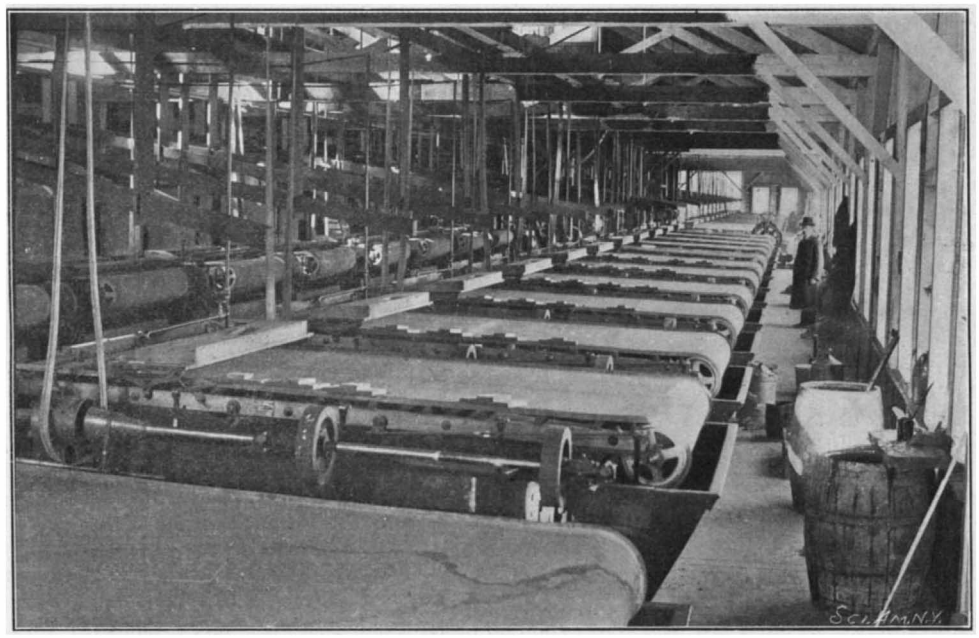
Sixty years ago the Dahlonega gold belt was a familiar name. From about 1835 to 1849, Dahlonega, Georgia, was the principal gold mining center of the United States. So great was the importance of this field that, in 1838, the government established at Dahlonega the first branch United States mint. And from 1838 to the date of its closing in 1861, because of the war, 1,381,784 pieces of gold money, with total value of $6,115,569, were coined at this mint. And this sum is less than one-half of the estimated output of the field during that period, a time when the methods of extracting the gold were very crude and wasteful. Probably from 50 to 90 per cent of the gold in the ore escaped over the old style mercury plates. White's statistics of Georgia, published in 1849, declare that from 1829 to 1849, twenty years, Lumpkin County, of which Dahlonega is the county seat, itself produced 20,000,000 dwts. of gold.

After the war the Federal government gave the mint and grounds to the trustees of the North Georgia Agricultural College. The mint building was used as a college for a number of years, until it was destroyed by fire; but soon afterward, upon the same massive foundations, was erected the present fine main building of this flourishing institution. Fifty years ago the interest and excitement over the discovery of the famous California gold fields overshadowed the Dahlonega gold belt; and the war closed the mint and so changed things generally that the very existence of this belt passed out of general public attention. Moreover, the local financial and other conditions have not been favorable to a strong revival of the gold mining here until the present time.

The earliest discoveries in this belt, in about 1829, were of free gold; and placer mining, the washing and panning of the disintegrated rock waste that had accumulated in the valleys and beds of streams, was the first stage of the gold mining. The next stage was washing down and crushing the oxidized and partly disintegrated auriferous rock, called "saprolite," washing the sand, thus formed, over mercury-covered plates and amalgamating and catching the gold set free. Some free gold also was caught in the sluice basins.

But it was found that beyond about one hundred feet from the surface of the ground the gold-bearing rocks were so little oxidized that the gold could not be extracted in this manner. A large part of the gold is in quartz rock, but mixed with compounds of sulphur and iron, forming "sulphurets," in which the gold is protected from amalgamation with mercury.

To successfully unlock the royal metal from this secure embrace has long been the hope of those acquainted with the situation. No ordinary processes would do it. Science, machinery and plants expensive and complicated are needed to do this work. And just now this new era in gold mining here is beginning to dawn. Within eighteen months six great mining companies have been organized in the immediate vicinity, with a total capital of $20,000,000, to bring into use the latest and best scientific means of extracting the gold in a large way.



FRUE VANNER CONCENTRATING MACHINES.

The gold is present in practically unlimited quantities, in formations that have long been pronounced by eminent geologists and mineralogists to be "true fissure veins of injection." The ore is very rich. It is easy of access. Conditions of climate and seasons are almost ideal, being far enough south to avoid winter's blasts, and sufficiently elevated to temper summer's heat. All that is necessary to develop the precious metal in abundant quantities is modern machinery and judicious management.

The Dahlonega Consolidated Gold Mining Company, the pioneer of these new mining companies, has made the most progress at this time in the work of erecting its plant and developing the gold. And as its mill is the largest east of the Rocky Mountains, and is one of the largest in the United States, and as the plant as a whole has been pronounced by competent judges to be the peer in completeness and modern, up-to-date, scientific efficiency of any in the world, a description of it will be of special interest. Nothing that thought or money could supply has been spared to make it in every way complete for its purpose.

This company was organized in November, 1898, and is composed principally of Ohio capitalists. The erection of the mill was begun in June, 1899, and it is expected that it will be substantially completed and formally started about June 20, 1900.

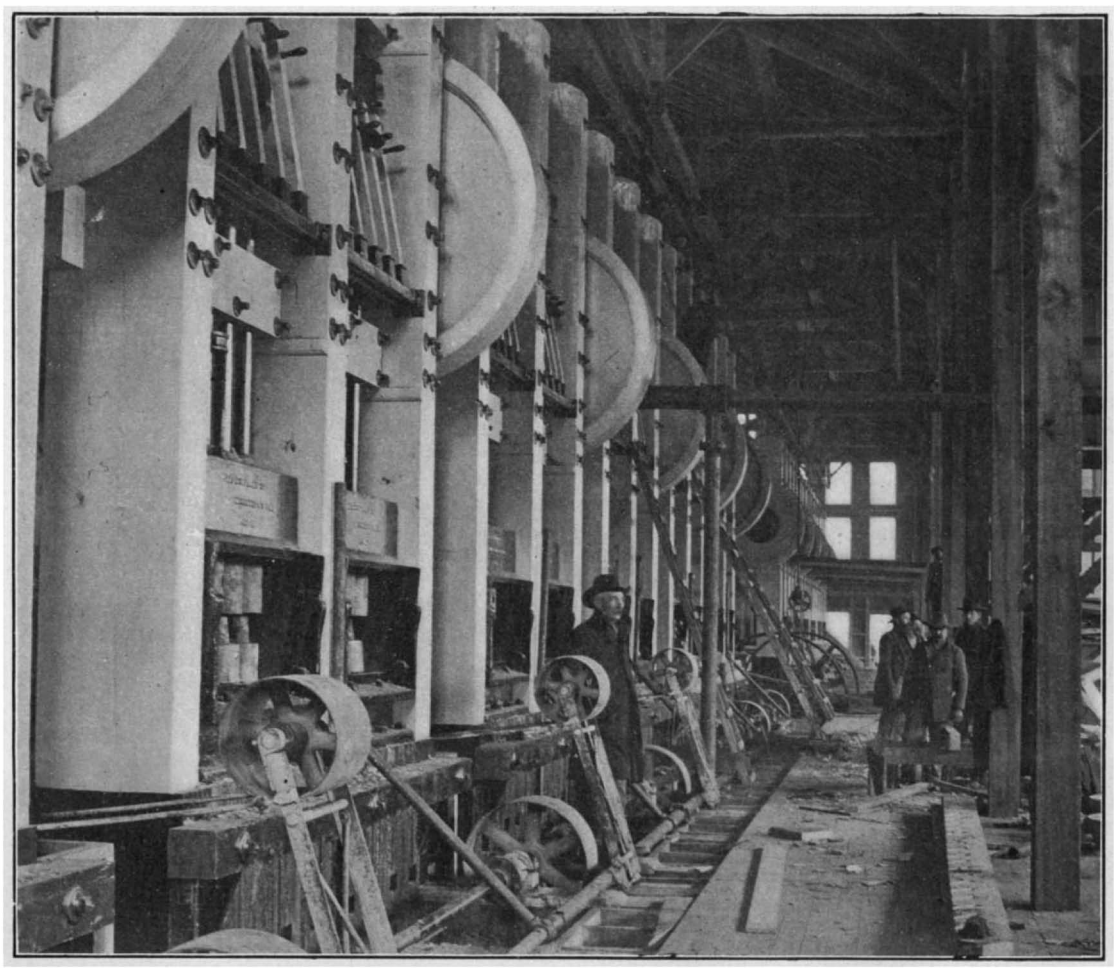
The plant is located on the banks of the Yahoola River, within the corporate limits of the city of Dahlonega, within a mile of the public square. It is in the very midst of a perfect network of rich gold veins, the hills all around being largely composed of auriferous rock, the outcroppings of veins striking into the earth to unmeasured depths. It is proper to add that this company owns about 7,000 acres of gold ore and fine magnetic iron ore land, all within five miles of Dahlonega. And all of the other mining companies have large holdings nearly or quite as rich in gold.

This plant consists of a stamp and concentrating mill, 300 by 100 feet, and four stories high; a chlorination plant, 128 by 128 feet and four stories high; two shaft houses, each 120 by 40 feet; a blacksmith and machine shop, 84 by 36 feet; a carpenter shop and storehouse, 84 by 36 feet. All these buildings are most substantially constructed and are covered, sides and roof, with No. 24 corrugated iron plates.

The stamp mill has 120 stamps, each of 850 pounds weight, arranged in batteries of ten each. The stamps fall a distance of about 9 inches at the rate of 90 strokes per minute, and have capacity of crushing to powder 600 tons of ore per day, running day and night. The entire plant will be run both day and night. This mill is also equipped with 48 Frue Vanner concentrating machines.

Adjacent to the mill building is a great ore bin or pit, 300 by 60 by 22 feet, with a capacity of 27,000 tons of ore. The ore is carried from the mines on tram cars propelled by electricity to this bin and automatically dumped. From the bin the ore passes to the large crusher, a No. 6 Gates. This reduces the ore to pieces about the size of hickory nuts. A No. 2 Gates crusher adjacent to the larger one will reduce any lumps that fail to pass the screen. An endless bucket hoist carries the crushed ore up to the belt on the fourth floor that distributes it to the stamps on the third floor. By them it is reduced to a pulp, water being admitted here. This pulp is washed over mercury-covered plates on the second floor, that amalgamate and catch the free gold. The remainder is carried by wooden conduits to the Frue Vanner concentrating machines on the first floor. These each have a table 6 by 13 feet, formed of an endless belt of rubber with "egg-shell" surface, that, as it slowly rotates, receives a lateral motion of about 200 vibrations per minute. The gold concentrates thus extracted are thence sent to the chlorination plant for treatment.

The remaining pulp or sand, after the gold has been



STAMP BATTERY WHERE THE ORE IS CRUSHED READY FOR THE AMALGAMATING BATTERY.

REPAIRING 44-INCH WOODEN PIPE IN THE HAND DITCH.

thus extracted, passes down to the basement, and through underground conduits is washed into the Yahoola River.

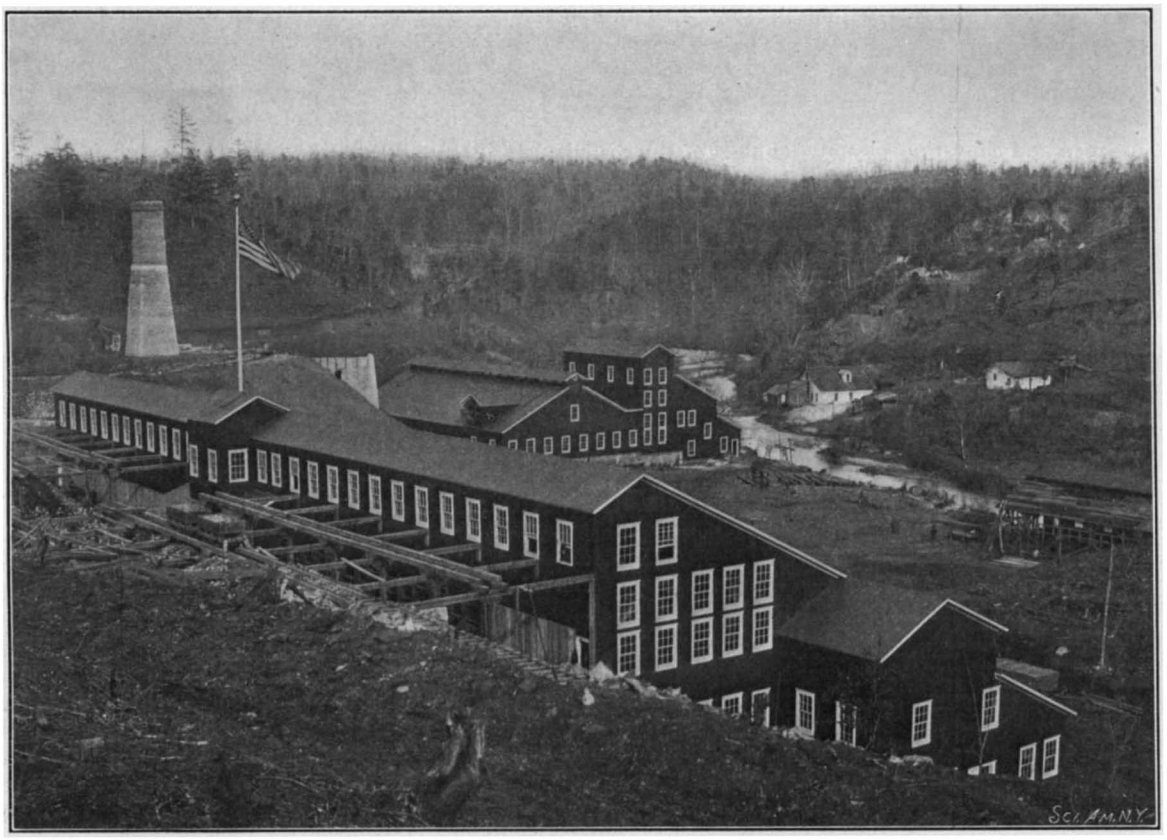
The stamp mill is run by water power. The hand ditch conveys the water from the Yahoola River to a reservoir, on a hill near the mill, and under a head of 235 vertical feet, the water is admitted through a 44-inch wooden tube, at a pressure of about 100 pounds per square inch, upon the Pelton water wheels, each of 500 horse power and each capable of running the mill. The water escaping through two nozzles of 2 and 2½ inches diameter at each wheel is forced against cups on the periphery of the wheels, and under full power uses about 2,900 cubic feet of water per minute. The smaller 40-horse power wheels operate the Frue Vanner concentrating tables. The drills in the mines are operated by a 200 horse power air compressor. Two dynamos are driven by the water power; one for operating electric lights for the mill, mines, plant and premises; and a power dynamo for propelling the ore tram cars, as heretofore noted.

The hand ditch is itself a remarkable piece of engineering skill. It brings water from a point in the Yahoola River about seven miles from Dahlonega. But on account of the many ridges around which it must travel, its course is very sinuous, and it is nearly 20 miles long. It was begun in 1859, but was not completed until after the war. Its construction cost over $300,000, and required the excavation of over 5,000,000 cubic feet of earth, and the blasting of thousands of tons of rock. The open part of the ditch is 6 feet wide at the bottom; 10 feet wide at the top; vertical depth, 4 feet. But in eight places it is carried across deep ravines through great inverted siphons, and across streams in iron tubes from 38 to 48 inches in diameter, and in spans from 200 to 3,840 feet in length. The total length of this tubing is 10,526 feet. Flowing at full capacity this ditch will discharge at the mill 4,000 cubic feet of water per minute.

From the stamp mill the concentrate ore is carried on tram cars to the chlorination plant and dumped through a hopper into the roasting furnace. This is 100 feet long and 14 feet wide, and about 9 feet high, and is on the ground floor. About two and one-half hours are required for the ore to traverse this; as it is slowly carried along it is constantly stirred by revolving robbles. This furnace is heated by four fireboxes, using wood fuel. The iron flue chamber, 6 feet in diameter and 90 feet long, leads to a chute of masonry 45 feet long, and it to the brick stack, 66 feet high. The capacity of this furnace is twenty-five tons of concentrates every twenty-four hours. This process expels the sulphur.

Beneath this furnace, and of the same length and width, is the cooling hearth on which the roasted ore is slowly carried back, being stirred and cooled, to the hopper end. Here a screw conveyer moves the ore about 30 feet to the elevator that carries it to the storage bin on the fourth floor. From here it passes by gravity to the charge hopper and scales, on the third floor, where it is weighed for charging the chlorination barrels, on the second floor. These are charged with ore, water, sulphuric acid, and calcium chloride. There are two of these barrels, each of five tons capacity. They are of steel, lined with ½-inch lead, cylindrical, 5 by 8 feet inside measurement, and are swung horizontally. When charged and sealed they are rotated at about six revolutions per minute for three to five hours. The solution is then washed out of the barrels, hose attachments being provided; but within the barrels are filters that retain most of the tailings. This filtrate solution containing the gold passes into settling tanks on the first floor, where it remains about twenty-four hours. It is then conveyed by a Montjose air pressure tank into the two precipitate tanks, each 8 feet cube, on the second floor, where jets of hydrogen sulphide from a generator are introduced under pressure at the bottom, and this gas passing up through the solution precipitates the gold chloride. This precipitate is then by air pressure forced through the filter in the basement story. The gold chloride is here caught on the filter paper and canvas. It is then roasted, fluxed, smelted, and cast into bars—the precious metal. The entire process, for a given mass of ore, requires about 36 hours.

The power for this plant is furnished by a 20 horse power electric motor using current from the stamp mill dynamo.



GENERAL VIEW OF THE DAHLONEGA GOLD MINING PLANT.

The Consolidated Gold Mining Company has now in its employ about 600 men, and in full operation it will regularly employ about this number. It has already mined and ready for the mill over 50,000 tons of gold ore.

The Standard Gold Mining Company has begun the erection of another 120-stamp mill just across the river from the plant above described. Another roasting furnace, for which there is place, will be added to the chlorination plant, which will make it double throughout, and it will then serve both mills. This company's first order for lumber for the construction of the new mill provided for 1,000,000 feet.

The Crown Mountain Gold Mining Company has begun the erection of a 60-stamp mill, and will likely treat its concentrates by the cyanide of potassium process.

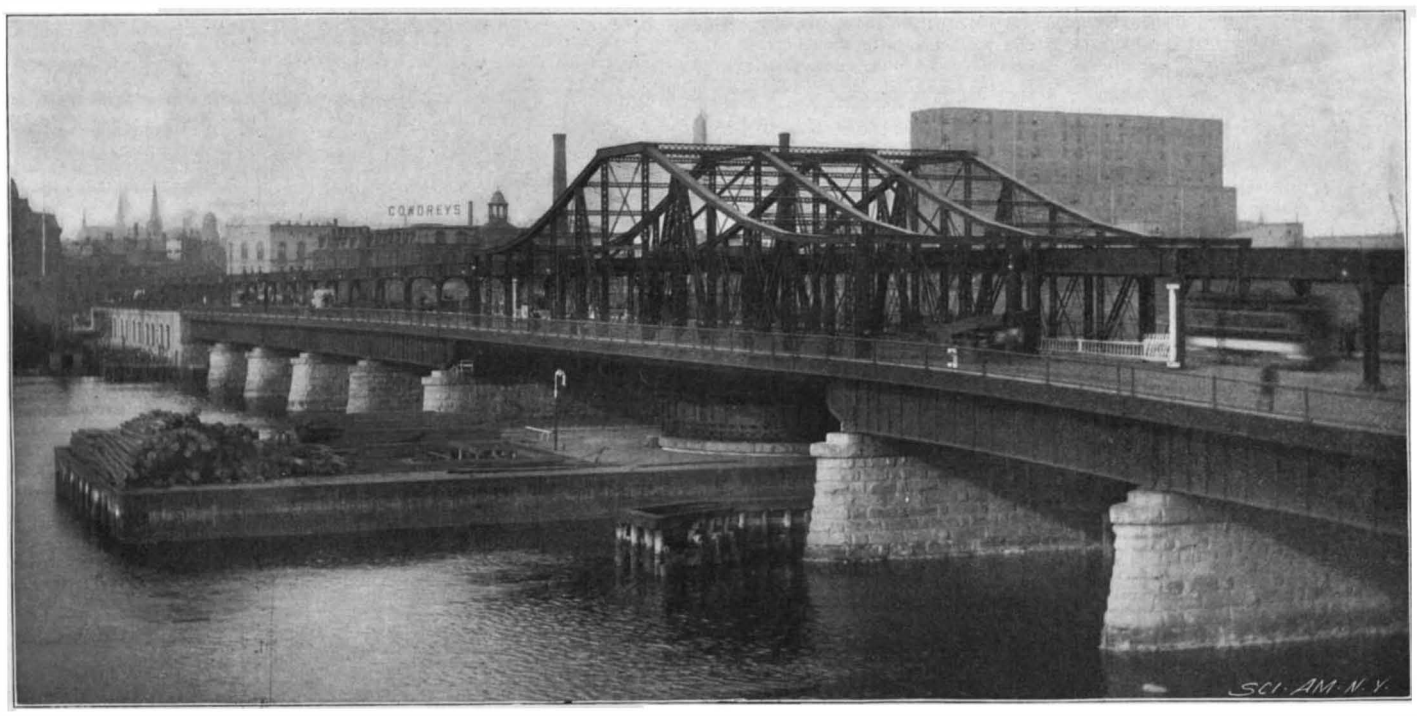
The Dahlonega Gold Mining Company and the Chicago New South Gold Mining Company, both recently organized, expect to build large mills, beginning this summer.

These are all near Dahlonega. But in several of the adjoining counties there is great activity in gold, copper, and iron mining, and North Georgia bids fair to soon become relatively more prominent as a mineral and gold mining center than it was two generations ago.

THE ELEVATED RAILWAY DRAWBRIDGE, BOSTON.

The large drawbridge herewith illustrated forms an important link both in the elevated railway and street car systems and in vehicle and pedestrian traffic across the Charles River, Boston. The elevated railway accommodates the through traffic from Dudley Street, Roxbury, to Sullivan Square, Charlestown, a distance of about 4½ miles. At the point of crossing, there is also concentrated a large amount of street railway traffic, in addition to a considerable volume of surface travel, for which the new bridge will form the natural point of crossing.

The total length of the bridge with its approaches is 1,920 feet, of which about 1,000 feet is built across the water. The fixed spans of the approaches, which are of plate-girder construction, are each 85 feet in length, while the draw-span has a total length over all of 240 feet. The total width of the bridge is 100 feet, the space being occupied by two 10-foot sidewalks, two 29-foot roadways, and a space at the center 22 feet wide for the accommodation of the street railways. The draw-span, which weighs 1,200 tons, has several features of interest, among which may be mentioned the fact that it consists of four parallel trusses, this being, we believe, the only instance in which this number has been used in a bridge of this kind. It rotates on a circular track which is 54 feet in diameter. The load is carried upon seventy solid, cast steel wheels, which are 26 inches in diameter. The motive power and machinery for operating the draw are located in a room beneath the floor of the bridge and in the center of the turntable. The draw is opened and closed by means of two 28 horse power railway motors. They are placed outside the power house, one on each side of the turntable, with which they are connected by the usual shafting and gears.



Span, 240 feet; width, 100 feet; weight, 1,200 tons.

NEW ELEVATED RAILWAY DRAWBRIDGE, BOSTON.

The draw-span is provided with eight hydraulic jacks, four at each end, which are utilized to lift the ends of the draw when it is closed. The rams are located vertically beneath the end posts of the trusses, those beneath the two outer trusses having a capacity of 100 tons each, and those beneath the two inner trusses having a capacity of 200 tons each. When the draw is closed, the ends are raised 3½ inches, and a

series of steel wedges which serve to hold the draw in position are thrown into place by means of a lever.

A novel feature of this bridge is the fact that over a portion of its width it is double-decked, the upper deck being of the same height as and forming a continuation of the elevated railway above referred to. The elevated structure is 18½ feet above the surface of the roadway, there being a clearance of about 14 feet from the surface of the roadway to the under side of the plate girders. The plate girder spans of the fixed portion of the bridge are, as we have said, each 85 feet in length, while the span of the elevated structure girders is just one-half as great, the columns which carry them being located alternately upon the masonry piers and at the center of the 85-foot plate girders below.

As it takes about ten minutes to open and close the draw, an arrangement has been made by which a switchman at the end of each approach to the bridge will be notified by an electric signal whenever the draw is to be opened. This will enable him to switch the surface cars on to the other tracks, which will carry them across the river by means of a bridge located a short distance up the river.

The grade of the approaches to the bridge is nowhere greater than three per cent. The structure is brilliantly lighted throughout, and thus far it has not only proved itself to be a thorough success in operation, but it forms one of the most sightly and attractive engineering features of the city.

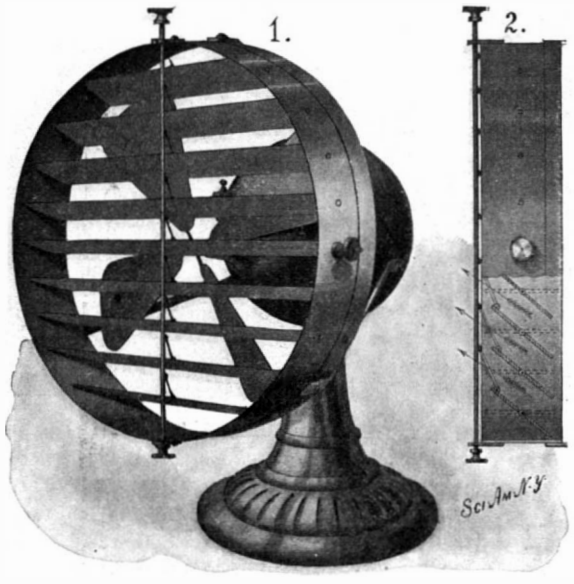
Observations of the Sun's Spots.

A memoir has been recently published by Mr. Christie, Royal Astronomer of England, in the monthly record of the Royal Astronomical Society. The memoir treats of the mean surface and latitude of the sun spots which have appeared during the year 1898, these having been deduced from a series of photographs taken at the Observatory of Greenwich, at Dehra Dun, India, and at Mauritius Island. The year 1898 has been marked by three principal eruptions of spots. The first commenced the 6th of March by the simultaneous appearance, at equal distances from the equator, of two large groups of spots. The second of the series, and the most remarkable, made its appearance on the 11th of August, under the form of one, then of two minute spots. This group was almost insignificant up to the time of its disappearance near the western border on the 16th of August, but became very striking upon its reappearance, on the 3d of September, its extent increasing from day to day. It arrived at a maximum (0·002235 of the sun's visible surface) on the 10th of September, and then commenced to decrease. It was still of considerable size at its third appearance on the 30th of September, but afterward diminished rapidly, and on its fourth return, the 28th of October, only a few small spots remained. The third remarkable group of the year appeared on the 28th of October, but was visible during a single passage only. The principal characteristics of the year 1898 have been the return of spots at a high latitude, 10·5°, compared with 8° in 1897. The number of days upon which no spots were seen has considerably increased, this being 48 in 1898, 32 in 1897 and 8 in 1896. The year 1898 resembles greatly the year 1896 by the mean daily surface of spots, their mean distance from the equator and the number of days without spots. If the diminution follows the course of the last cycle, the next minimum will arrive at the beginning of 1901.

AN AIR-DIRECTING DEVICE FOR ELECTRIC FANS.

A device by means of which the blast of air discharged from an electric fan can be thrown in any direction is the subject of an invention which has been patented by Edgar Tripp, of Port of Spain, Trinidad.

Rigidly connected with the casing of the fan is a circular carrier mounted directly in front of the fan-blades. The carrier is provided with segmental slats, through which project the studs of a ring. The ring, therefore, can rotate to a certain extent with respect to the carrier. In the inner portion of the ring a series of slats are hinged on parallel axes, each slat being pivoted to an operating-bar fitted to slide in guides. In order to secure the slats in any position after adjustment, the axes of the central slat is extended and provided with a clamping nut.



THE TRIPP AIR-DIRECTING DEVICE FOR FANS.

The device is simply enough operated. According to the angle at which the slats are adjusted, the current of air produced by the fan is discharged horizontally, as usual, or deflected upwardly or downwardly. By rotating the ring in the carrier, the axes of the slats are inclined so that the air is deflected to the right or to the left, as well as upwardly or downwardly. When the ring is turned so that the slats are in a vertical position, the deflection of the air is wholly lateral. By the use of the device there is no necessity for changing the position of the fan, since the air can be deflected at any angle desired.

ABBE MAREUX has discovered by means of the great telescope at the Paris Exposition a remarkable solar spot which is part of an extended group, having a diameter of 25,000 miles. This information was cabled over to The New York Sun.

The Current Supplement.

The current SUPPLEMENT, No. 1279, is commenced by an article entitled "China and the Chinese," giving detailed references and a plan of Peking. "The Eclipse of the Sun in Spain" is also illustrated. "The Gutenberg Celebration" is accompanied by several interesting reproductions of old prints and types and the article is particularly timely, owing to the celebration which occurs this month. "The Rolling Platform of the Exposition of 1900" describes its operations in detail. "United States Mineral and Metal Production" is accompanied by valuable tables.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

COTTON-SCRAPER.—JAMES M. SUGG, Harkey, Ark. The invention is an improvement in implements used in scraping the soil away from rows of cotton-plants before they are hoed, thus leaving the plants on a tapering ridge. The implement devised by Mr. Sugg scrapes from both sides of a row at the same time, permits the adjustment of the scraping-blades with respect to each other, and enables the man who is following the scraper to observe at all times the position of the blades while scraping.

Electrical Apparatus.

AUTOMATIC ELECTRIC SWITCH.—PHILL S. TIERILL, Groveton, N. H. It is often desirable to operate "long-burning" arc-lamps from the regular mains and to control them from a central station. For this purpose the inventor finds a light iron wire amply sufficient. His switch requires energy only for the instant it is in operation. It can be used as an entrance-switch. At places where the entrance is effected at inconvenient places, the switch is particularly serviceable. By the use of the switch, a push-button can be located at any convenient place, and the entrance-switch can be operated at any convenient predetermined point. The device can also be used as a three-point or "lazyman's" switch.

Engineering Improvements.

COMBUSTION-ENGINE STARTING AND REVERSING DEVICE.—EDWARD S. HAINES, Jacksonville, Fla. The gas-engines in common use cannot be started merely by feeding carbureted fuel to the cylinder. The crank-shaft must be manually turned by means of a hand-wheel or the like, necessitating the expenditure of much effort. To obviate the difficulty the inventor has devised a very ingenious and simple mechanism by which the engine is automatically started and reversed, thus saving time and labor.

ROTARY ENGINE.—GEORGE C. ROHDE, Gunnison, Colo. This engine has ports opening at the side of the piston-disk. A steam-chest incloses the ports, and comprises two parts, one consisting of a disk having segmental openings or ports, and the other consisting of a member having segment-arms designed to close the openings in the disk and to turn in order to vary the port-opening. A sleeve is secured to the adjustable or turning member of the valve and has teeth on its periphery arranged at right angles. A rod entering the steam-chest has teeth extending in rows and engaging the teeth of the adjustable valve member, whereby the valve can be moved bodily toward or away from its ports and turned about its axis.

Gas Apparatus.

ACETYLENE GENERATOR.—OLIVER D. FRY, Altoona, Penn. The apparatus comprises a gasometer and a number of generators designed to contain water and carbid. Water-receptacles communicate with the generators and are located at opposite sides of the gasometer. Displacers are carried at opposite sides of the gasometer-bell and are movable in the receptacles to force the water in and out of contact with the carbid. The oppositely-arranged displacers serve to balance the bell and can be weighted to increase the pressure on the gas within the bell.

CARBURETING-LAMP.—ARTHUR L. TABER, Corona, Cal. The inventor has devised a simple, economic, and effective apparatus for feeding inflammable vapor to a burner. He has succeeded in supplying a steady flow of oil to the vaporizing chamber and in insuring the generation of the vapor in the chamber by means of drafts of air rather than by the direct application of heat.

GAS-STOVE.—WILLIAM J. RANCK, Columbus, Ohio. This invention relates to a burner and stove adapted especially for use in connection with natural gas. The construction enables one to secure the greater portion of the heating energy of the gas, since the arrangement of the burner insures complete combustion. The tortuous course which the heated gases are caused to take, heats all parts of the stove and insures the radiation of the heat. The noxious gases are drawn off and a continuous circulation of air is maintained, thus producing a thoroughly healthful and efficient instrument.

Mechanical Devices.

DIAPHRAGM-MOTOR.—GEORGE W. LEWIS, Grinnell, Iowa. The motor is designed for driving various machinery, and is particularly well adapted for use in gas systems to pump the desired quantity of air to the carbureter, according to the amount of motive agent used in the gas-engine. A reservoir having a bell is joined by valved pipes with a number of pumps. These pumps are actuated by the diaphragm-motor, means being provided for controlling the admission and exhaust of the motive agent to and from the motor-cylinders. A rack-bar, connected with the diaphragms, is geared with a shaft to actuate the pumps. The motor and pump are completely automatic in operation.

SCREW-PROPELLER.—PETER G. LAVIGNE, Napa, Cal. By the improved form of blade provided, a much greater surface area, and hence propelling power, is gained, compared with an ordinary wheel of the same diameter and length of hub. Such power is still further increased by the varying pitch of the blade; for the pitch is extreme on the edge which first takes hold of the water, and the blade is so formed that churning is almost entirely obviated. This result is due to the principle of securing the necessary pitch by the conformation of the blade independently of the angle made by the blade with the axial line of the hub. A rim is combined with the blade in order to overcome the centrifugal effect of the revolving wheel.

Miscellaneous Inventions.

ATTACHMENT FOR BOOK TYPE-WRITERS.—JULIA K. MCDANIEL, 312 A Street, Washington, N. E., D. C. The invention is an attachment to the Elliott and Hatch book type-writers which have a hinged platen, vertically adjustable at its free end. The invention provides means for adjustably supporting the free end of the platen, whereby it may be secured and supported at any desired height.

BUCKSAW.—HUGH HENRY, Ennis, Tex. This bucksaw comprises a frame having top and end bars. To the top-bar a handle-bar is pivoted, having a lever-arm extending thereover and provided in its upper side with notches. A sliding loop or ring is fitted over the top bar and lever-arm, and engages the notches. The saw-blade, by reason of this construction, can be easily tightened. It will be observed that the use of threaded tension-rods is avoided.

ANCHOR.—AUGUST S. PETERSON, Battle Lake, Minn. This anchor is made with pivoted fluke-arms, so that when the anchor is not in use and is hauled upon the deck of the vessel, both fluke-arms can be readily closed, so as to occupy as little room as possible. Fouling or entangling of the anchor-chain or rope is completely prevented.

RAZOR-GUARD.—T. F. CURLEY, 6 Warren Street, Manhattan, New York city. The invention provides an improved razor-guard which is readily attachable to or removable from the razor and is easily adjusted to bring the guard in proper position relatively to the edge of the blade. The guard-bar is formed at its ends with screw-threaded lugs on which nuts screw. The outer nut has a pin designed to enter an opening in the outer end of the back of the razor. The inner nut is formed with a fork for engagement with the back of the razor. A fastening device holds the guard in position.

ELEVATOR AND SEPARATOR FOR GOLD.—SCHUYLER C. and WILLIAM N. RUBLE, Golden, Ore. In carrying out the invention, the placer material is treated so as readily to separate the fine, gold-bearing material, by subjecting the placer material first to the action of a stream of water under pressure to set the material in motion and then subjecting the moving placer material to the action of a second stream of water under pressure at an angle to the first stream, to drive the material up an incline and allow the fine material to separate from the coarse and to pass by its own gravity and the assistance of the water through openings in the incline, while the coarser material travels farther up the incline to be finally discharged therefrom and piled up. After the separation of the fine from the coarse material, the former is gathered in a flume having riffles which finally separate the gold from the tailings.

Designs.

ORIENTAL CARPET.—HOVCEP SARAFIAN, Titusville, Penn. Three design patents have been secured by this inventor for oriental carpets of characteristic weave and color-scheme.

BADGE.—DENNIS C. FAUSS, Brooklyn, New York city. The designer has provided a neat pin for a girl's high school, the letters G. H. S. being tastefully combined in a monogram.

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(7908) L. M. R. asks: Does a bar of soft iron change in any dimension upon being magnetized? A. A bar of iron increases in length when magnetized. Joule found the increase to be $\frac{1}{7}\frac{1}{5}\frac{1}{5}\frac{1}{5}$ of the length. It has since been shown that by increasing the magnetizing force a point is reached at which the effect is reversed and the bar shortens. You will find this discussed in Thompson's "Elementary Electricity," price $1.40, a book which should be in your school library, in Section 124. Perhaps your physics class can devise and construct an apparatus for showing this elongation. It has been done. If you can make such a device, have a photograph of it taken, and send us a copy of it.

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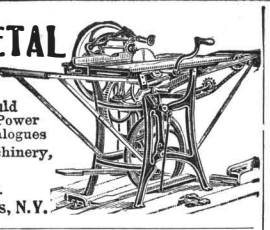

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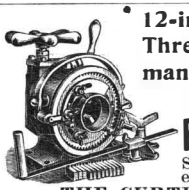

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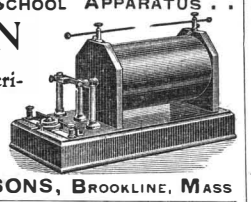

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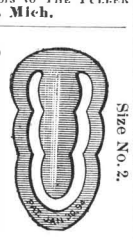

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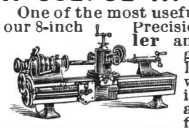

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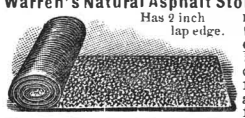

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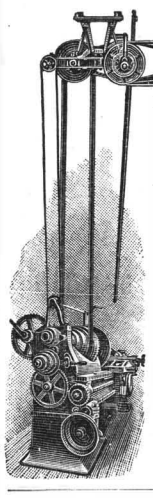

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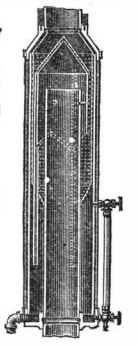

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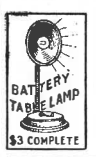

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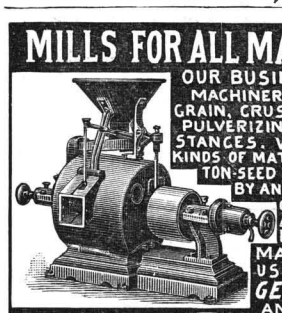

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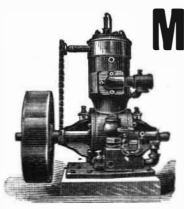

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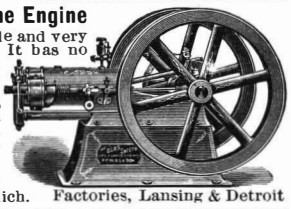

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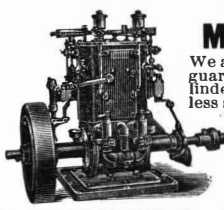

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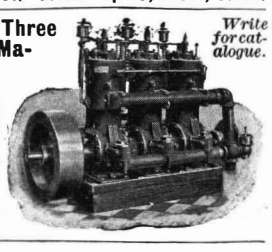

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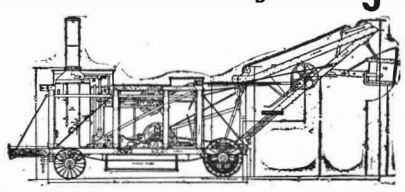

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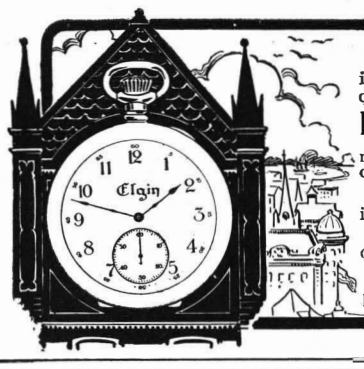

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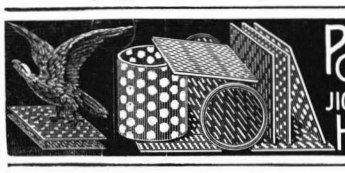

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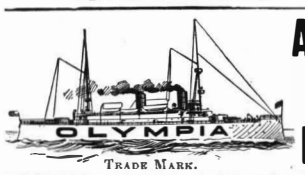

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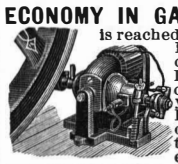

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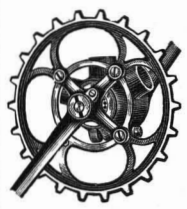

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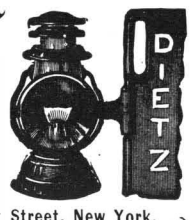

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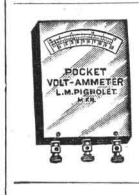

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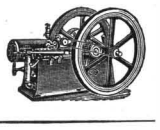

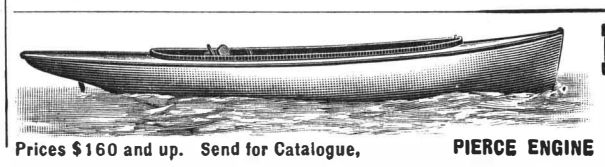

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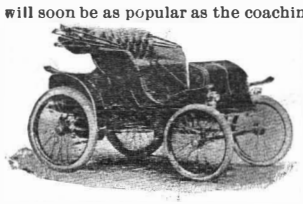

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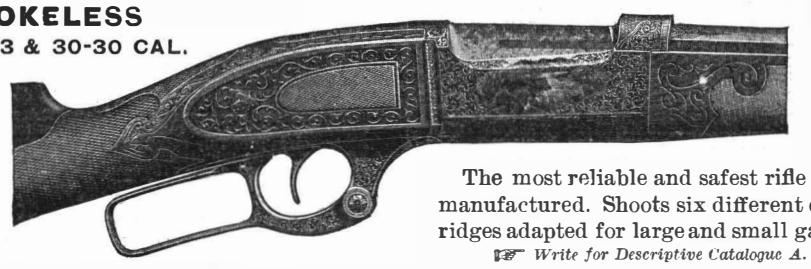

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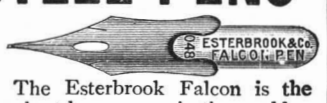

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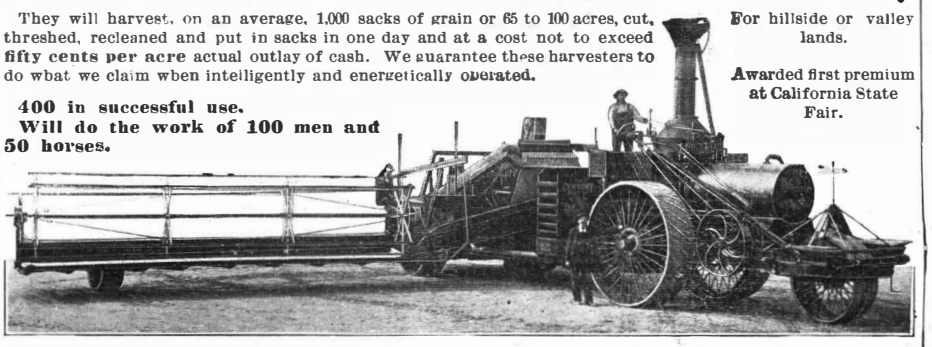

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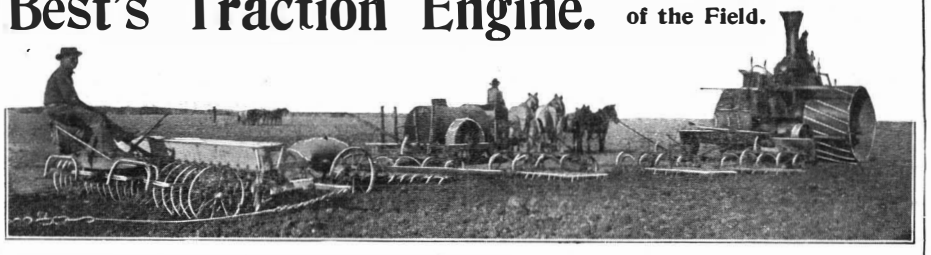

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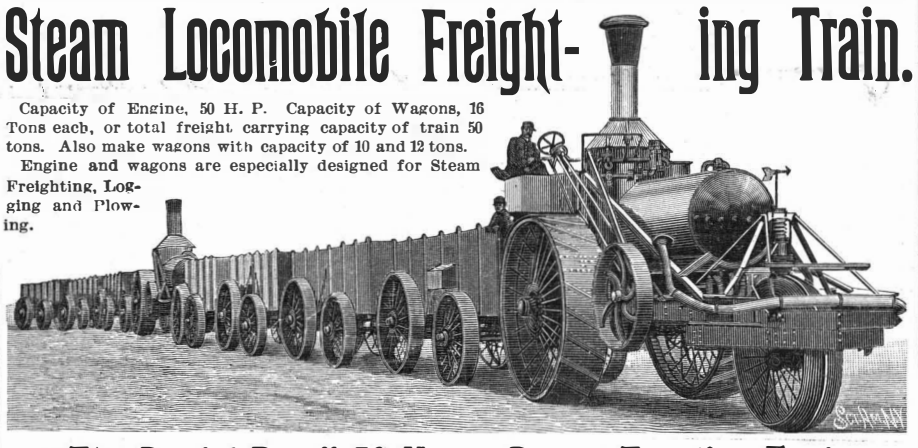

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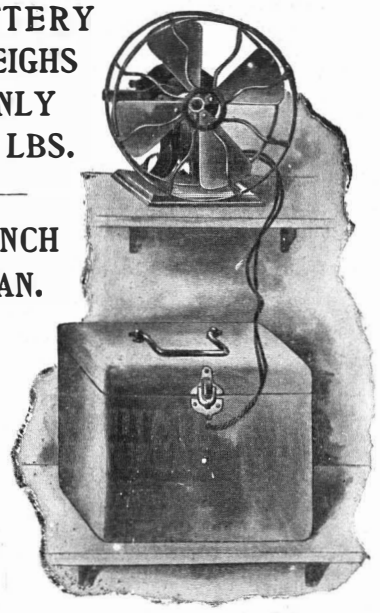

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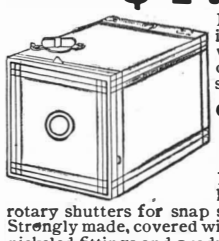

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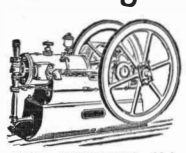

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